

TRaC Wireless Test Report : TTR-000729WUS1

Applicant : Carlo Gavazzi Group

Apparatus : Main Controller

Specification(s) : CFR47 Part 15.247 July 10th 2008

FCCID : Y55WSM0001

Purpose of Test : Certification

Authorised by :



: Radio Product Manager

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Section 1:

Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

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1.2 Tests Requested By

This testing in this report was requested by :

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1.3 Manufacturer

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1.4 Apparatus Assessed

The following apparatus was assessed between 19th – 31st January 2011

Main controller Unit

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulation	Measurement standard	Result
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: Part 15 Subpart C; 15.247	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart C; 15.207	ANSI C63.10	Pass
Occupied Bandwidth	Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2)	ANSI C63.10	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)	ANSI C63.10	Pass
Power Spectral Density	Title 47 of the CFR : Part 15 Subpart C; 15.247(d)	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.10	Pass
Digital Modulation	Title 47 of the CFR: Part 15 Subpart C; 15.403	-	
RF Safety	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)(5)	-	

Abbreviations used in the above table:

Mod	: Modification		
CFR	: Code of Federal Regulations	ANSI	: American National Standards Institution
REFE	: Radiated Electric Field Emissions	PLCE	: Power Line Conducted Emissions

1.6 Notes Relating To The Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, "Pass" indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 20 to 20 °C
Humidity	: 45 to 48 %

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2:**Measurement Uncertainty****2.1 Measurement Uncertainty**

For the test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated :

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**

Uncertainty in test result (Equipment – TRL05) = **1.08dB**

Uncertainty in test result (Equipment – TRL479) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**

Uncertainty in test result (Equipment – TRL05) = **0.113ppm**

Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**,

Uncertainty in test result (30MHz – 1GHz) = **4.6dB**,

Uncertainty in test result (1GHz-18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**

Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%**, Uncertainty in Amplitude measurement = **0.82%**

[11] Power Line Conduction

Uncertainty in test result = **3.4dB**

[12] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**

Uncertainty in test result = **1.32dB (amplitude)**

[13] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[14] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[15] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[16] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[17] Receiver Threshold

Uncertainty in test result = **3.23dB**

[18] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A:**Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

Spec	: Specification	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment	Ref	: Reference
L	: Live Power Line	Freq	: Frequency
N	: Neutral Power Line	MD	: Measurement Distance
E	: Earth Power Line	SD	: Spec Distance
Pk	: Peak Detector	Pol	: Polarisation
QP	: Quasi-Peak Detector	H	: Horizontal Polarisation
Av	: Average Detector	V	: Vertical Polarisation
CDN	: Coupling & decoupling network		

A1 6 dB Bandwidth

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2) requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
Temperature	20°C
EUT set up	Refer to Appendix C

Channel Frequency (GHz)	F_{lower}	F_{Higher}	Measured 6 dB Bandwidth (MHz)	Limit	Result
2.405	2.404230769	2.405833333	1.602	≥ 500 kHz	Pass
2.445	2.444214744	2.445849359	1.634	≥ 500 kHz	Pass
2.480	2.479182692	2.480865385	1.682	≥ 500 kHz	Pass

Plots of the 6 dB bandwidth are contained in Appendix B of this test report.

A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

Channel Frequency (GHz)	Conducted Peak Carrier Power (W)	Antenna Gain(dBi)	Limit (W)	Result
2.405	0.000459	0	1	Pass
2.445	0.000517	0	1	Pass
2.480	0.000495	0	1	Pass

Notes:

Conducted Measurement

Measured Peak Carrier power includes highest gain of any antenna to be used.

Highest Gain of any antenna to be used = 0dBi

Conducted measurements were performed with a temporary antenna connector provided by the client.

A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

Channel Frequency (GHz)	Peak Power Spectral Density (dBm)	Antenna Gain(dBi)	Limit (dBm)	Result
2.405	-17.59	0	8.0	Pass
2.445	-17.67	0	8.0	Pass
2.480	-17.30	0	8.0	Pass

Notes:

Conducted Measurement

Measured Power Spectral Density includes highest gain of any antenna to be used.

Highest Gain of any antenna to be used = 0dBi

Conducted measurements were performed with a temporary antenna connector provided by the client.

The resolution bandwidth on the analyser was set to 3kHz and trace set to max hold.

The span is set to 3MHz

The sweep time is 1000 seconds (Span/3kHz).

A4 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details: Bottom/middle/top	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	9 kHz to 25 GHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1.				No Significant emissions within 20dBm		

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance 15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed. All other emissions were at least 20dB below the test limit.

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

The limit in 100 kHz RBW = (Maximum Peak Conducted Carrier)-20dB

A5 Radiated Electric Field Emissions within the Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The radiated electric field emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : 3m alternative test site :

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details: 2.405 GHz	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	30MHz – 25GHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	HPF Loss (dB)	PRE AMP (dB)	FIELD ST'GH (dB μ V/m)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
1.	4809.71	52.92	1.3	32.8	0.7	32.3	55.42pk	590.20pk	5011pk
2.	4809.71	44.63	1.3	32.8	0.7	32.3	47.13Av	227.24Av	500Av

Radiated Electric Field Emissions within the Restricted Band 15.205 continued:

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details: 2.445GHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dBi)	FIELD ST'GH (dB μ V/m)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
1.	4890.13	53.84	1.3	33.10	32.40	0.6	56.44pk	663.74pk	5011pk
2.	4890.13	45.93	1.3	33.10	32.40	0.6	48.53Av	266.99Av	500Av
3.	7335.13	47.92	1.4	36.60	32.10	0.8	54.62pk	538.27pk	5011pk
4.	7335.13	37.20	1.4	36.60	32.10	0.8	43.90Av	156.67Av	500Av
5.	9780.16	48.19	1.8	38.10	31.60	0.6	57.09pk	715.31pk	5011pk
6.	9780.16	36.32	1.8	38.10	31.60	0.6	45.84Av	219.78Av	500Av

Radiated Electric Field Emissions within the Restricted Band 15.205 continued:

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details: 2.480GHz	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	HPF Loss (dBi)	FIELD ST'GH (dB μ V/m)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
1.	4960.08	51.24	1.4	33.2	32.50	0.5	53.84	492.04pk	5011pk
2.	4960.08	46.99	1.4	33.2	32.50	0.5	49.59	301.64Av	500Av
3.	7440.13	48.44	1.3	36.7	32.1	0.8	55.14	571.47pk	5011pk
4.	7440.13	36.85	1.3	36.7	32.1	0.8	43.55	150.48Av	500Av

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1
- 2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.
- 3 Measurements at 2400 & 2483.5 MHz were made to ensure band edge compliance.
- 4 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.
- 5 For Frequencies below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak	RBW=VBW= 1MHz
Average	RBW=VBW= 1MHz

These settings as per ANSI C63.10

The upper and lower frequency of the measurement range was decided according to 47 CFR 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (47 CFR 15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength μ V/m	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz)
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

Notes:

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation (dB)} = 20 \log_{10} \left(\frac{\text{measurement distance}}{\text{specification distance}} \right)$$

The results displayed take into account applicable antenna factors and cable losses.

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
Effect of Position of EUT cables & samples on emission levels	✓			
(i) Parameter defined by standard and / or single possible, refer to Appendix D (ii) Parameter defined by client and / or single possible, refer to Appendix D (iii) Parameter had a negligible effect on emission levels, refer to Appendix D (iv) Worst case determined by initial measurement, refer to Appendix D				

A6 Power Line Conducted Emissions

Previous power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1

The worst-case power line conducted emission measurements are listed below:

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1						No Significant Emissions within 20dB of the Limit

Results measured using the quasi-peak detector compared to the quasi-peak limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1						No Significant Emissions within 20dB of the Limit

Specification limits :

Conducted emission limits (47 CFR 15: Clause 15.207):

Conducted disturbance at the mains ports.

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 ²	56 to 46 ²
0.5 to 5	56	46
5 to 30	60	50

Notes:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels	✓			
(i) Parameter defined by standard and / or single possible, refer to Appendix C				
(ii) Parameter defined by client and / or single possible, refer to Appendix C				
(iii) Parameter had a negligible effect on emission levels, refer to Appendix C				
(iv) Worst case determined by initial measurement, refer to Appendix C				

A7 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 0 dBi.

A8 Unintentional Radiated Electric Field Emissions - 15.109

Preliminary scans were performed using a peak detector with the RBW = 100kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to :

3m open area test site :

3m alternative test site :

Test Details: Bottom/Middle/Top Channels	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	

The worst case radiated emission measurements for spurious emissions:

Ref No.	FREQ. (MHz)	MEAS Rx (dB μ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB μ V/m)	EXTRAP FACT (dB)	FIELD ST'GH (μ V/m)	LIMIT (μ V/m)
1.								No Significant Emissions within 20dB of the Limit	

Appendix B:

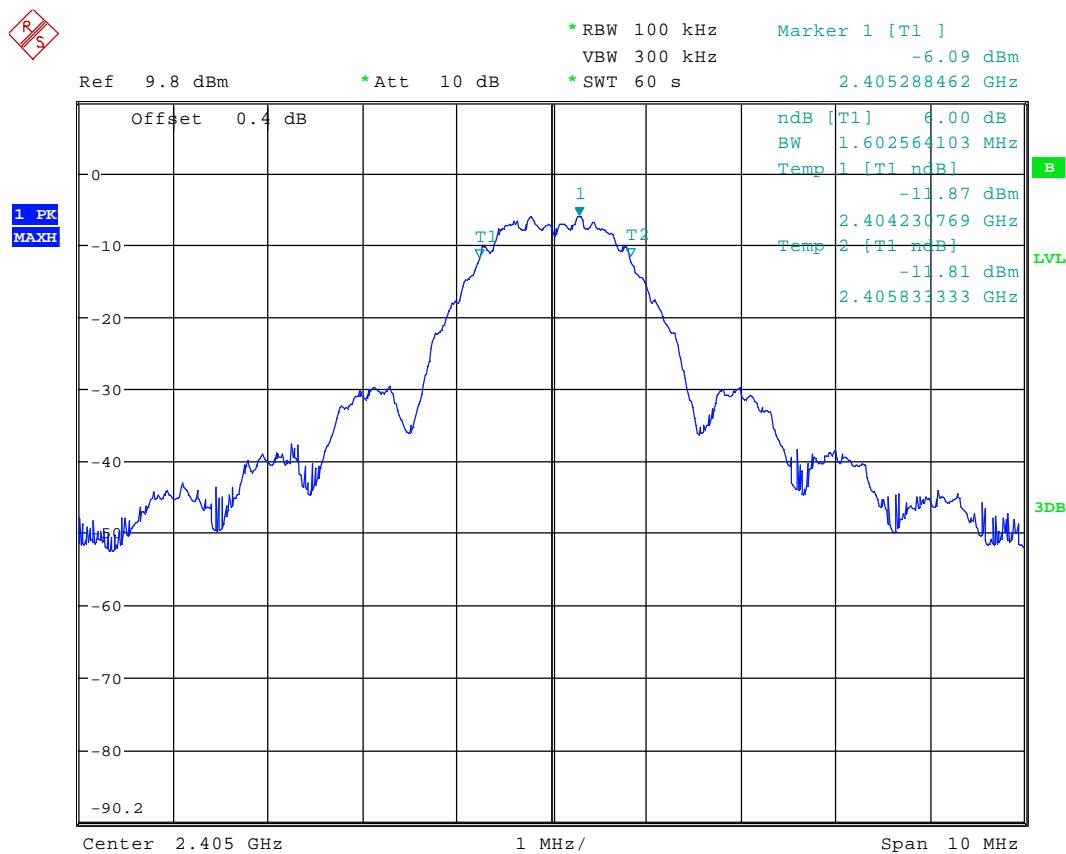
Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.
- (d) Appendix C details the numbering system used to identify the sample and its modification state.
- (e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

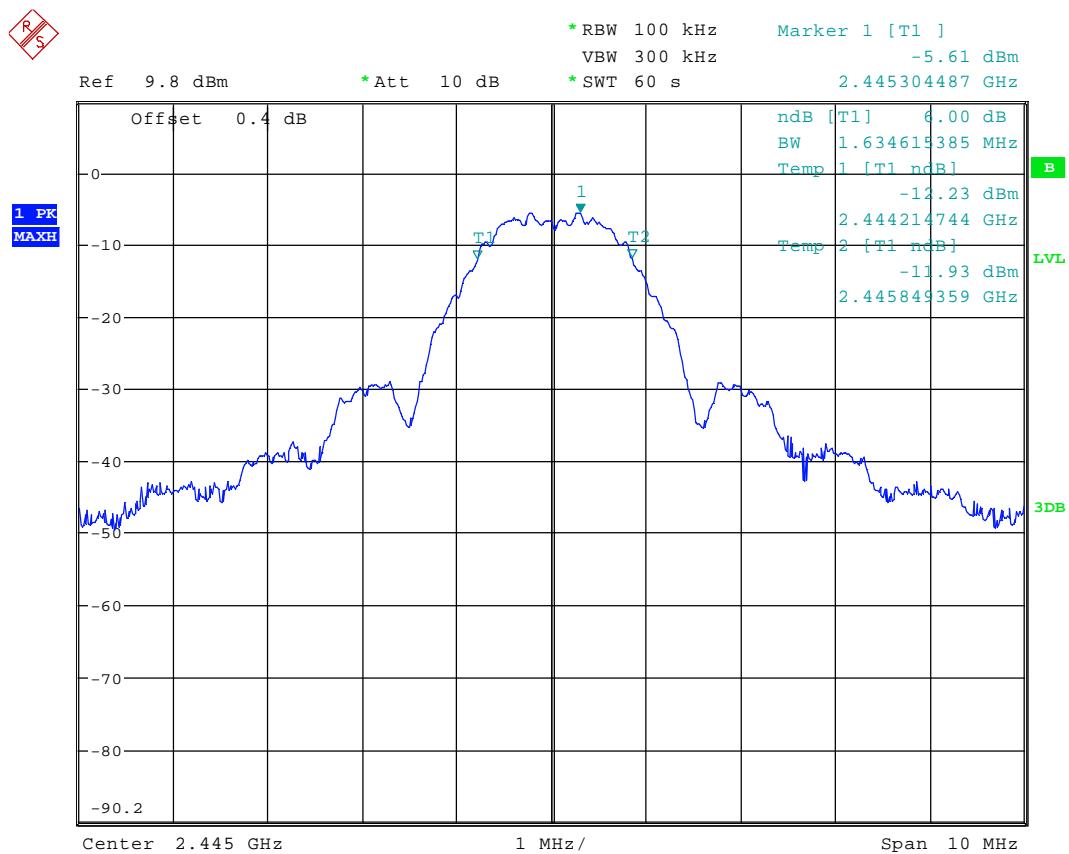
6dB Bandwidth Bottom Channel



Fl = 2.404230769GHz
 Fh = 2.405833333GHz

6dB Bandwidth = 1.602MHz

6dB Bandwidth Middle Channel



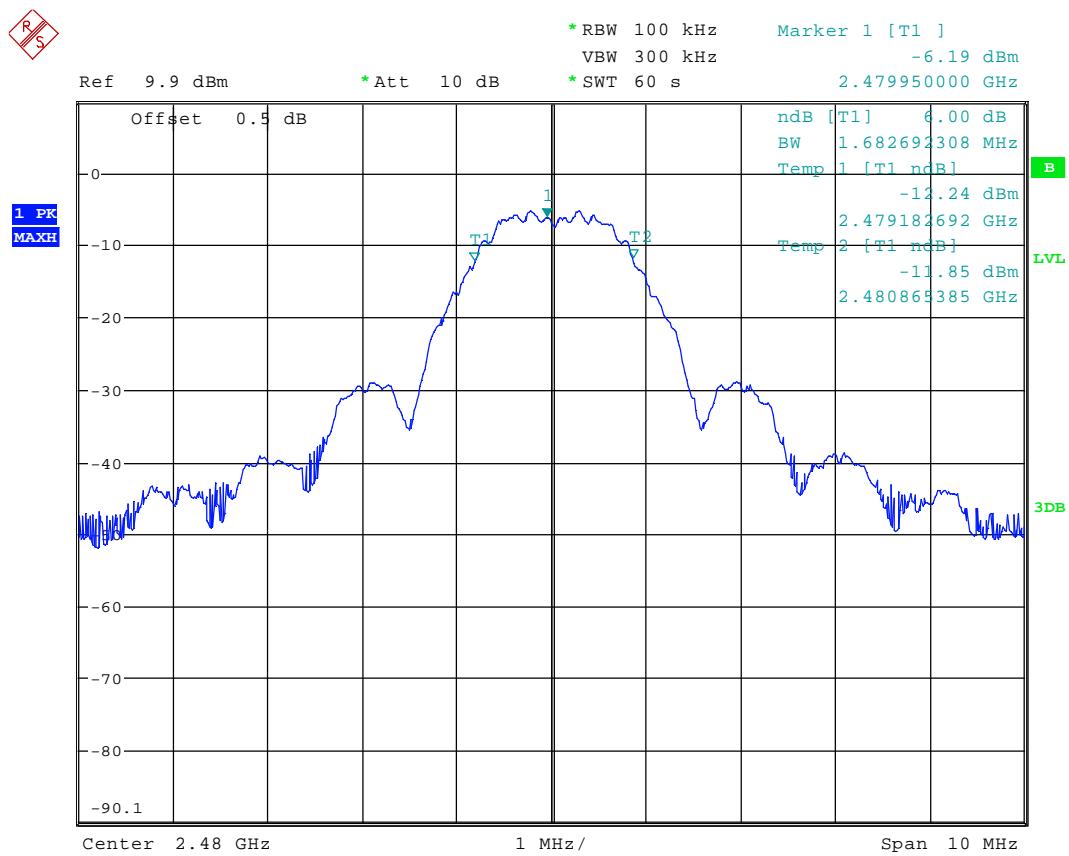
Date: 20.JAN.2011 09:42:15

$$F_l = 2.444214744 \text{ GHz}$$

$$F_h = 2.445849359 \text{ GHz}$$

6dB Bandwidth = 1.634MHz

6dB Bandwidth Top Channel

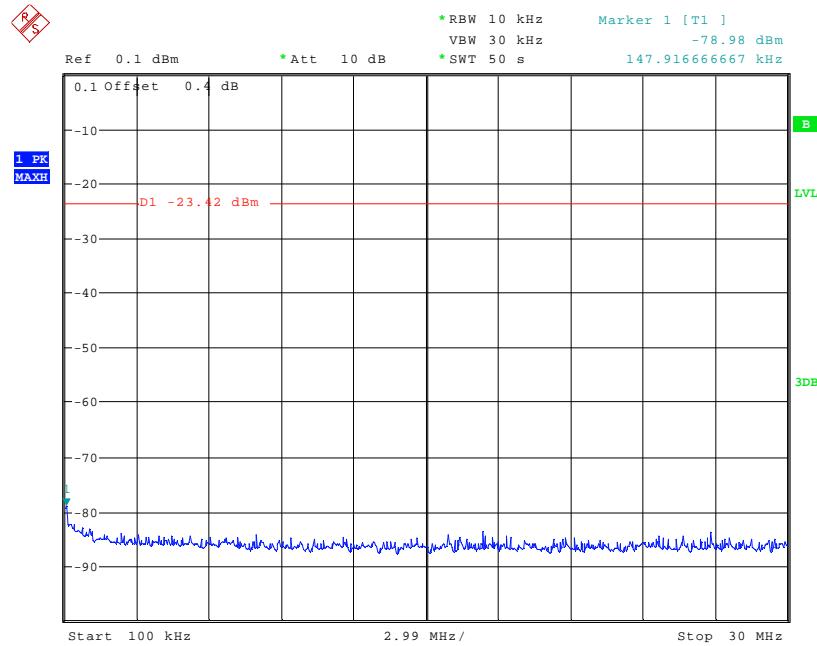


Date: 20.JAN.2011 10:01:14

$F_1 = 2.479182629\text{GHz}$
 $F_h = 2.480865385\text{GHz}$

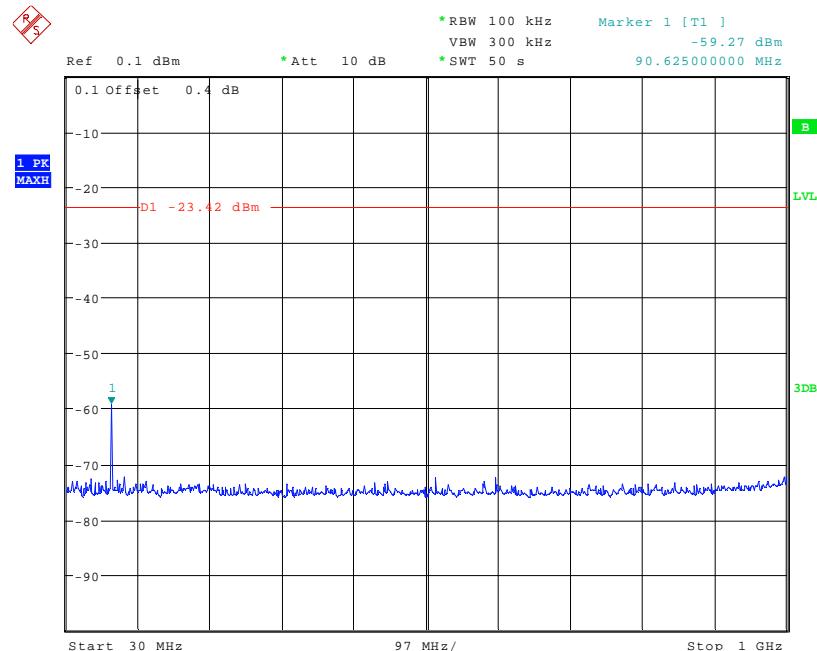
6dB Bandwidth = 1.682MHz

Conducted Spurious emissions 100kHz to 30MHz – Bottom channel



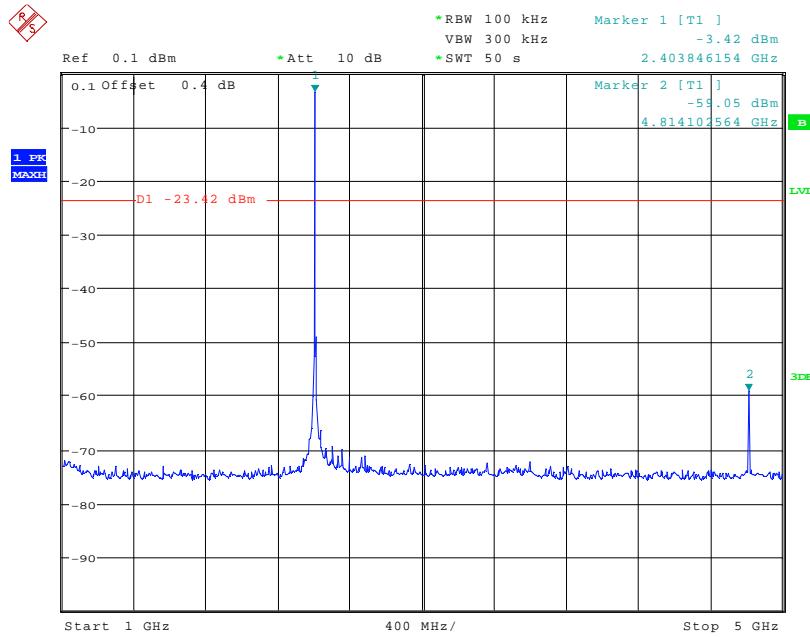
Date: 20.JAN.2011 10:51:12

Conducted Spurious emissions 30MHz to 1GHz – Bottom channel



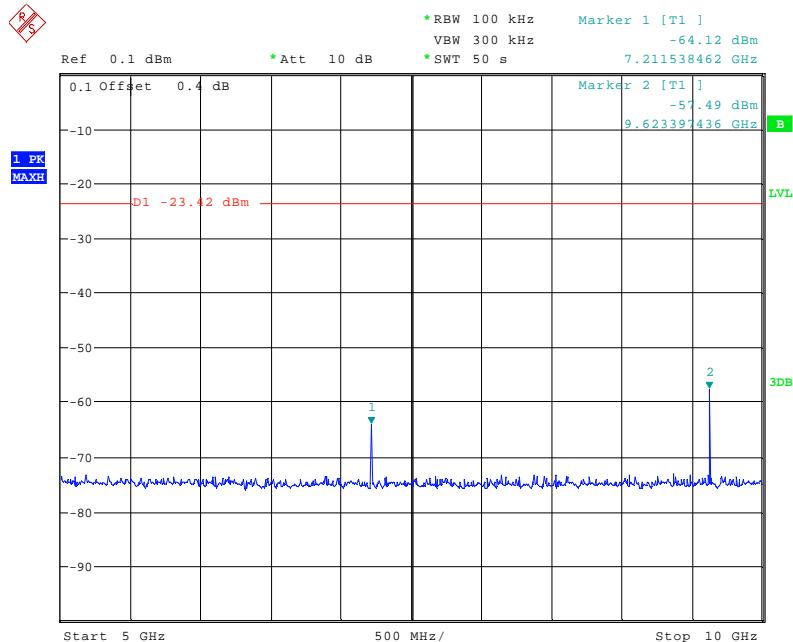
Date: 20.JAN.2011 10:52:27

Conducted Spurious emissions 1GHz to 5GHz – Bottom channel



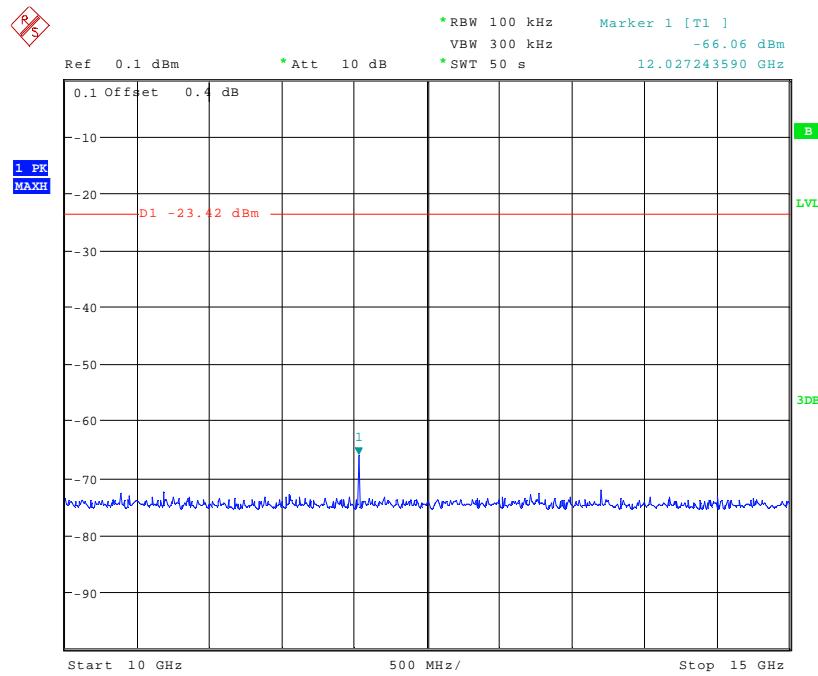
Date: 20.JAN.2011 10:49:58

Conducted Spurious emissions 5GHz to 10GHz – Bottom channel



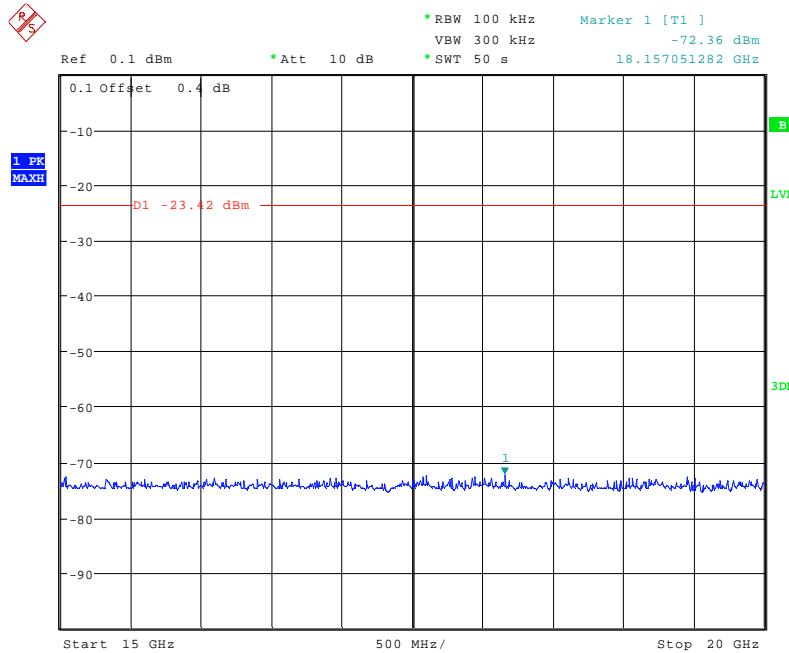
Date: 20.JAN.2011 10:53:37

Conducted Spurious emissions 10GHz to 15GHz – Bottom channel



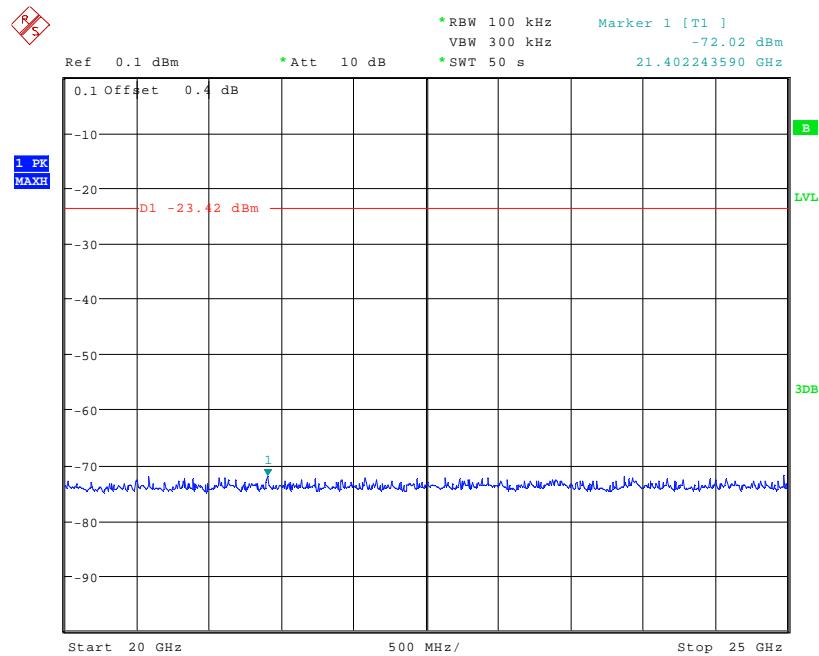
Date: 20.JAN.2011 10:54:46

Conducted Spurious emissions 15GHz to 20GHz – Bottom channel



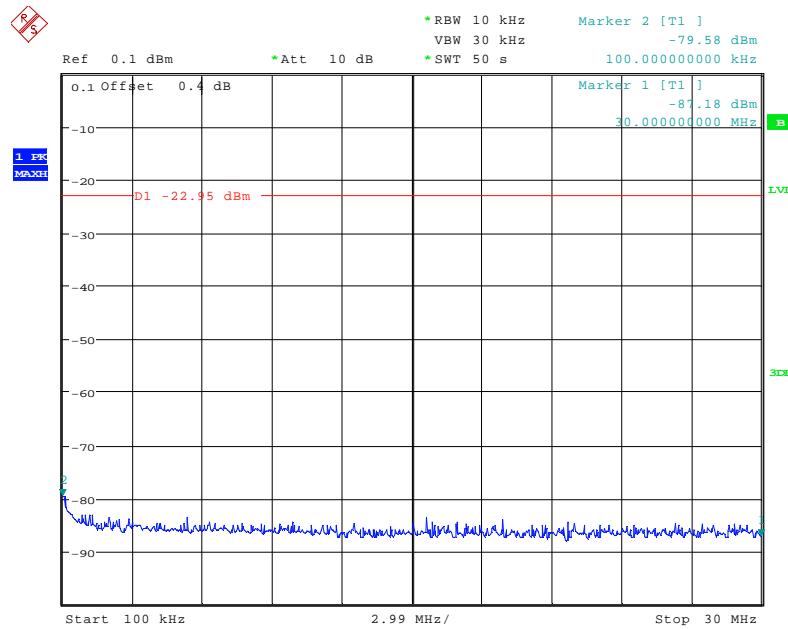
Date: 20.JAN.2011 10:56:06

Conducted Spurious emissions 20GHz to 25GHz – Bottom channel



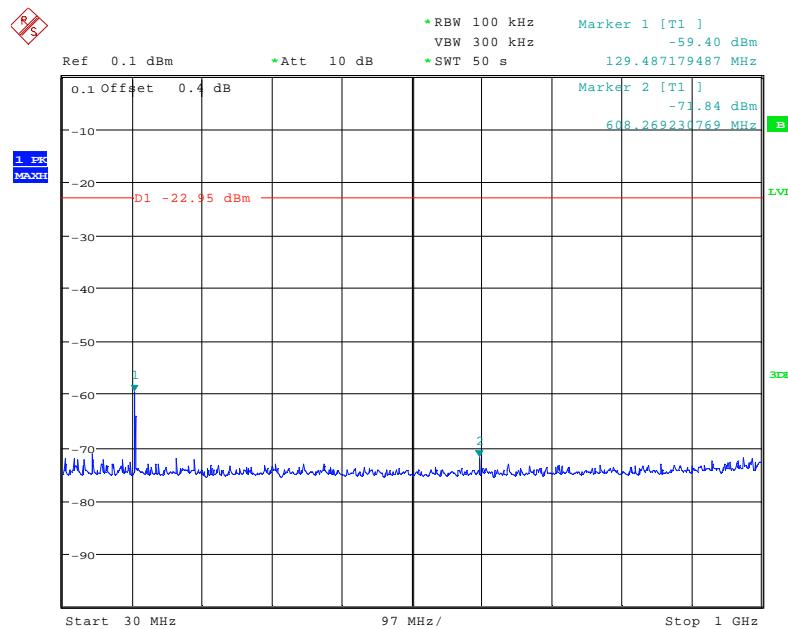
Date: 20.JAN.2011 10:57:20

Conducted Spurious emissions 100kHz to 30MHz – Middle channel



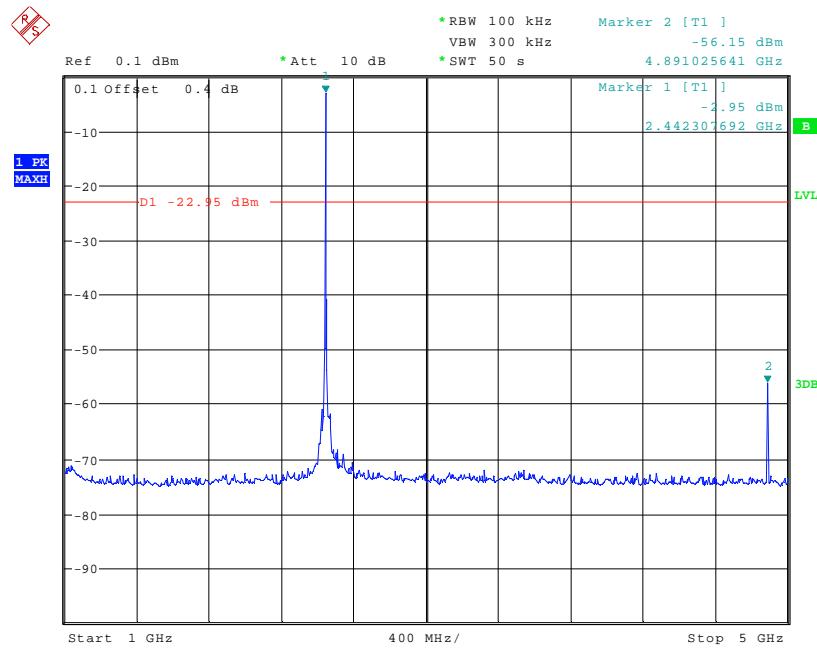
Date: 20.JAN.2011 11:03:14

Conducted Spurious emissions 30MHz to 1GHz – Middle channel



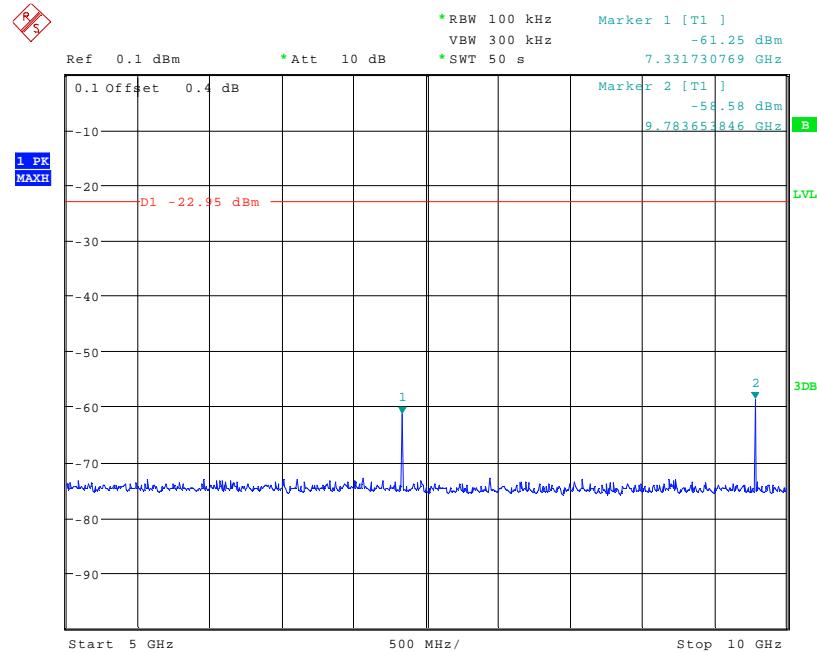
Date: 20.JAN.2011 11:05:40

Conducted Spurious emissions 1GHz to 5GHz – Middle channel



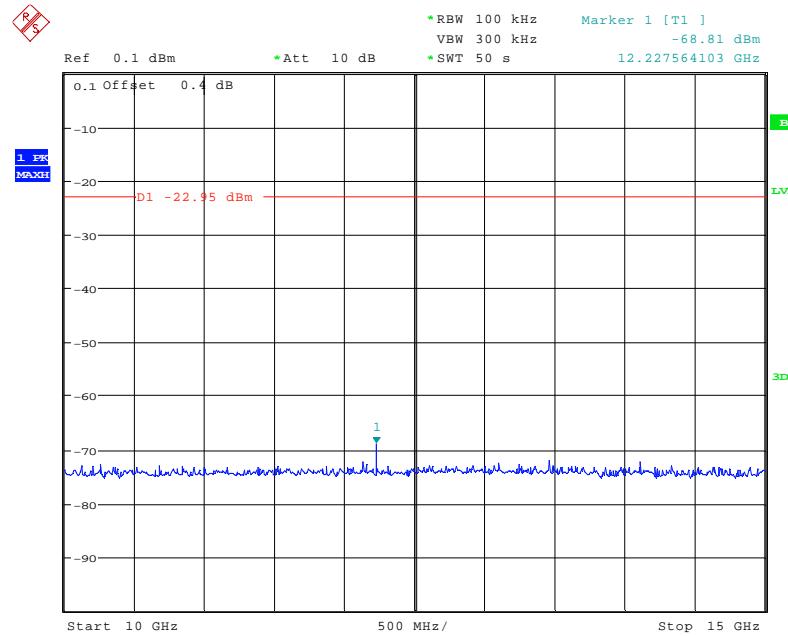
Date: 20.JAN.2011 11:01:49

Conducted Spurious emissions 5GHz to 10GHz – Middle channel



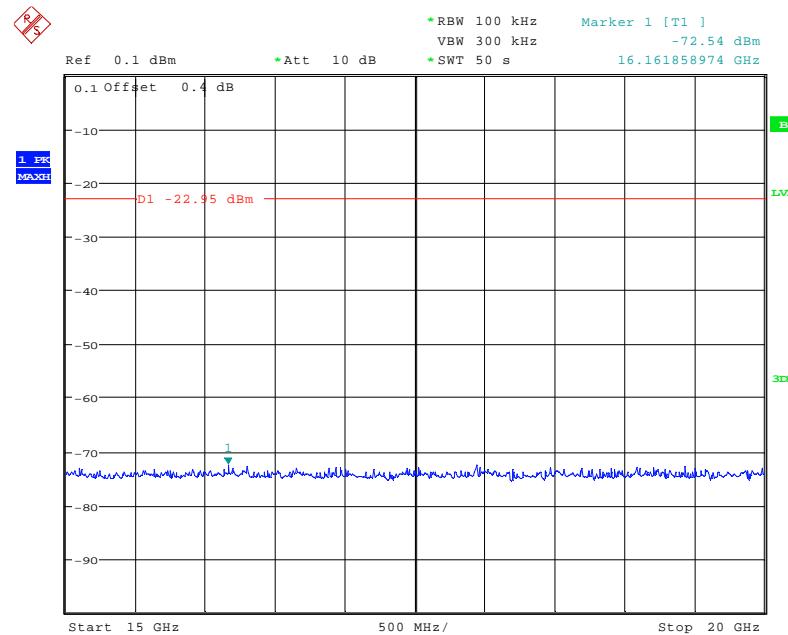
Date: 20.JAN.2011 11:07:04

Conducted Spurious emissions 10GHz to 15GHz – Middle channel



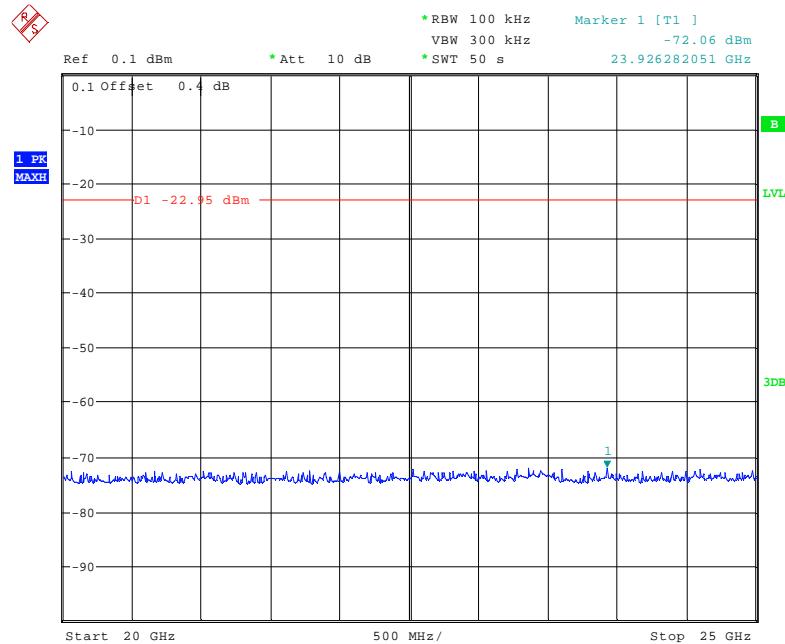
Date: 20.JAN.2011 11:09:30

Conducted Spurious emissions 15GHz to 20GHz – Middle channel



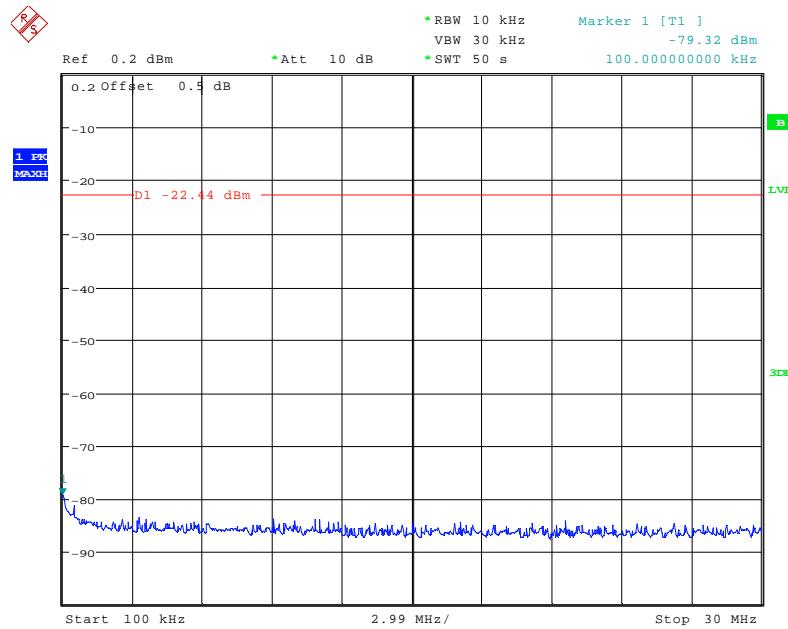
Date: 20.JAN.2011 11:10:49

Conducted Spurious emissions 20GHz to 25GHz – Middle channel



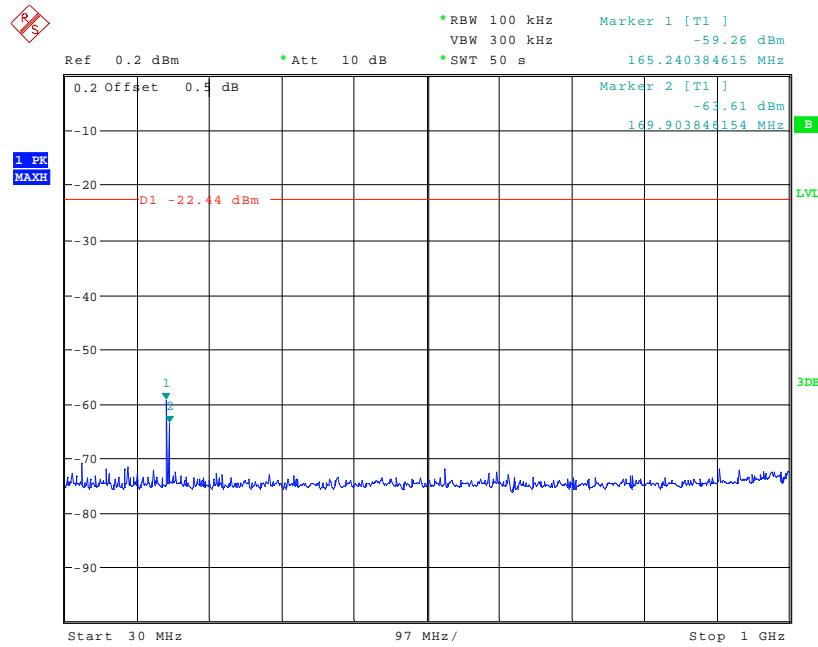
Date: 20.JAN.2011 11:12:01

Conducted Spurious emissions 100kHz to 30MHz – Top Channel



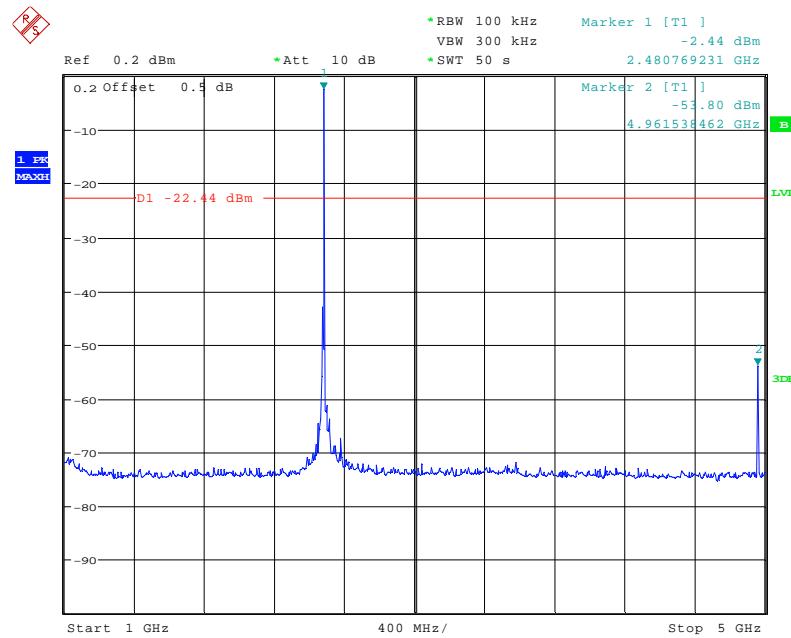
Date: 20.JAN.2011 11:16:48

Conducted Spurious emissions 30MHz to 1GHz – Top Channel



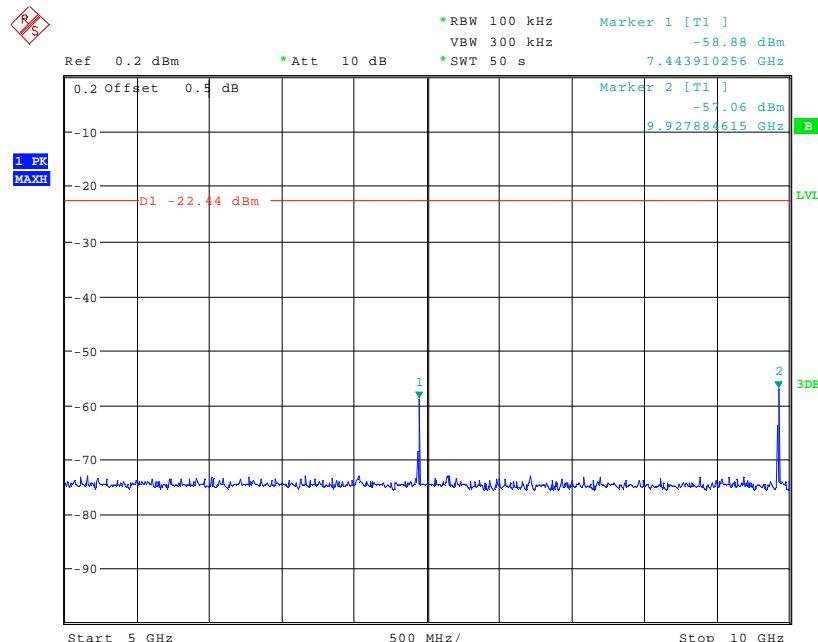
Date: 20.JAN.2011 11:18:22

Conducted Spurious emissions 1GHz to 5GHz – Top Channel



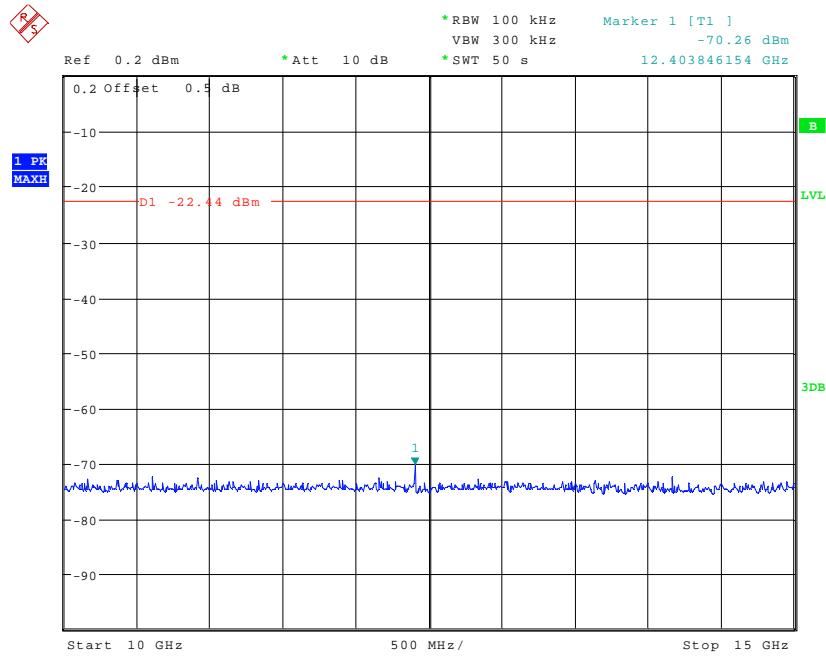
Date: 20.JAN.2011 11:15:27

Conducted Spurious emissions 5GHz to 10GHz– Top Channel



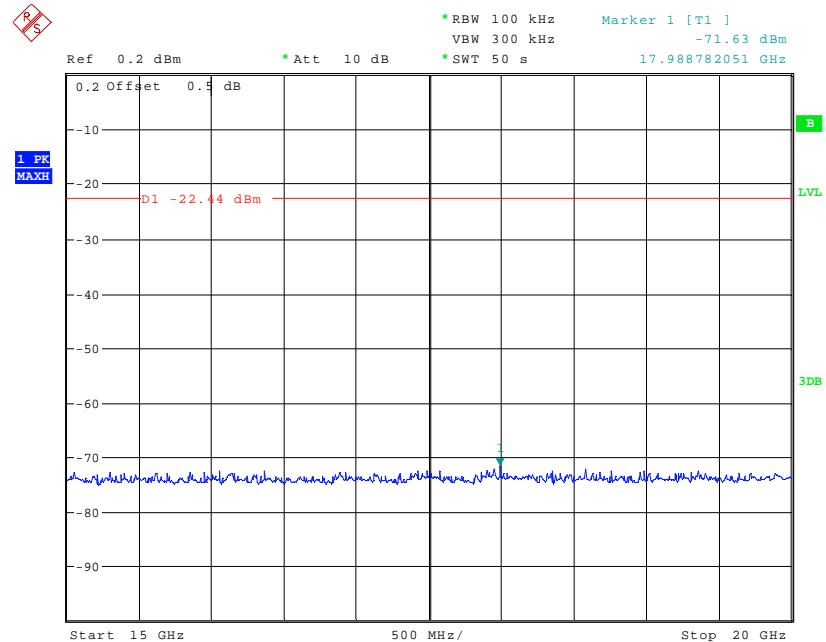
Date: 20.JAN.2011 11:19:49

Conducted Spurious emissions 10GHz to 15GHz– Top Channel



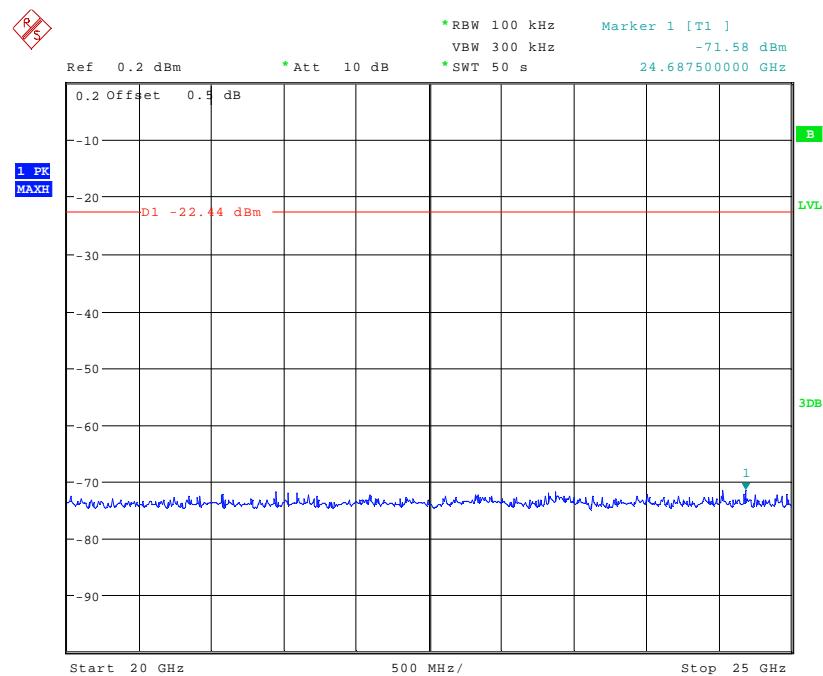
Date: 20.JAN.2011 11:21:09

Conducted Spurious emissions 15GHz to 20GHz– Top Channel



Date: 20.JAN.2011 11:22:58

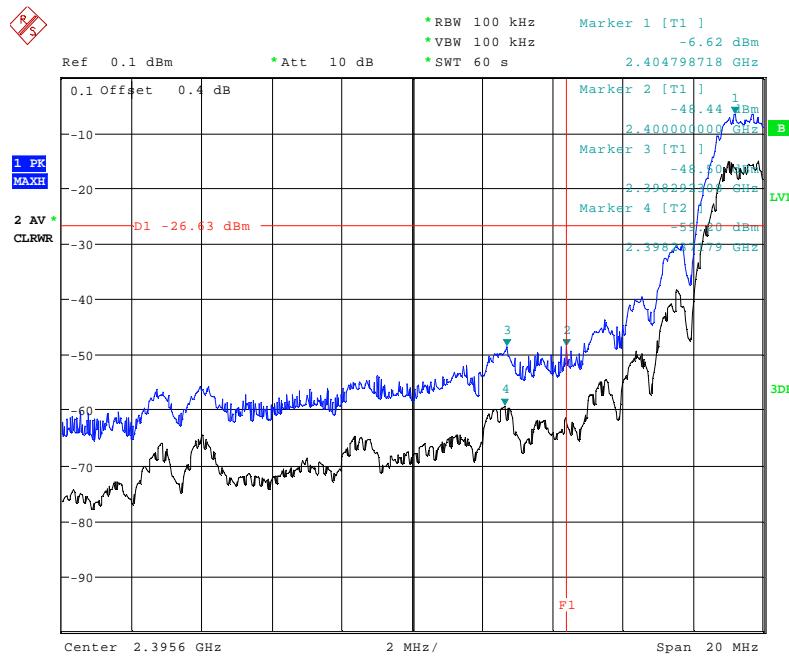
Conducted Spurious emissions 20GHz to 25GHz– Top Channel



Date: 20.JAN.2011 11:24:15

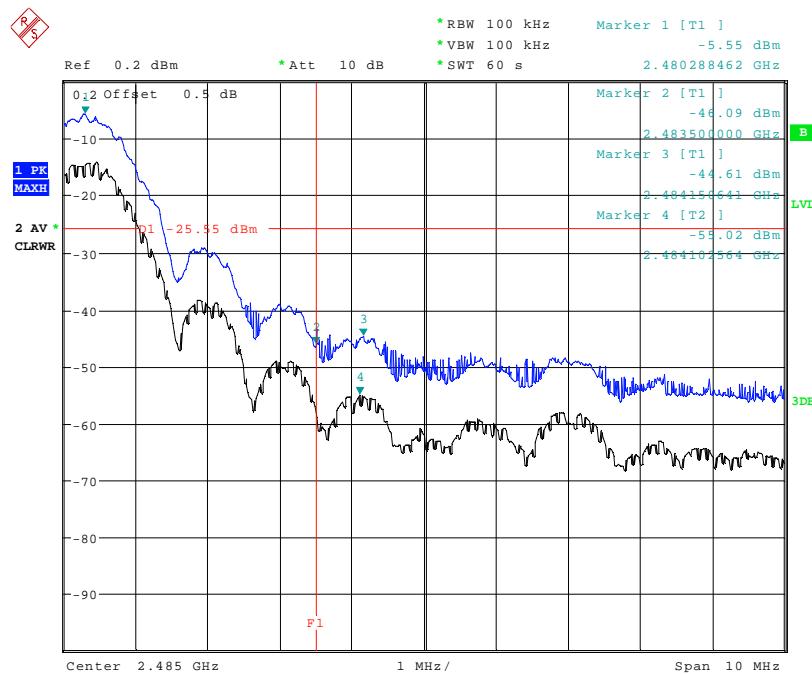
Conducted Bandedge Compliance

Lower Bandedge



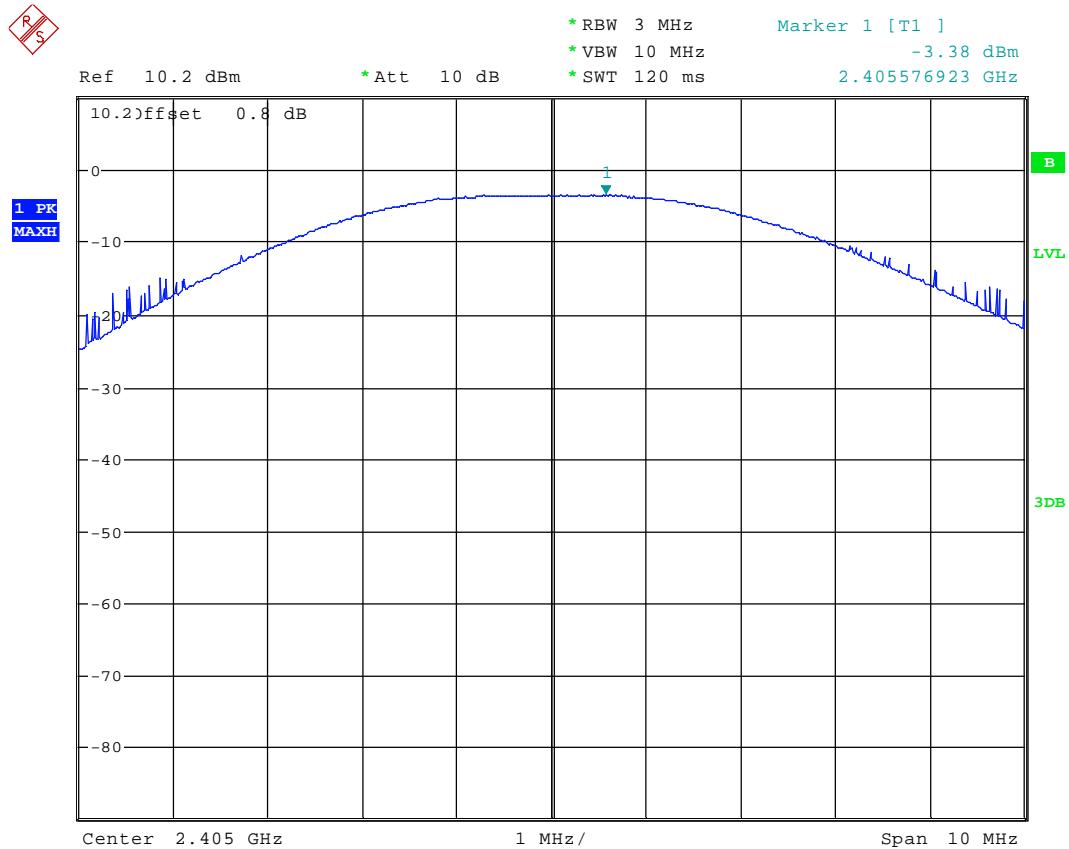
Date: 20.JAN.2011 11:37:58

Upper Bandedge



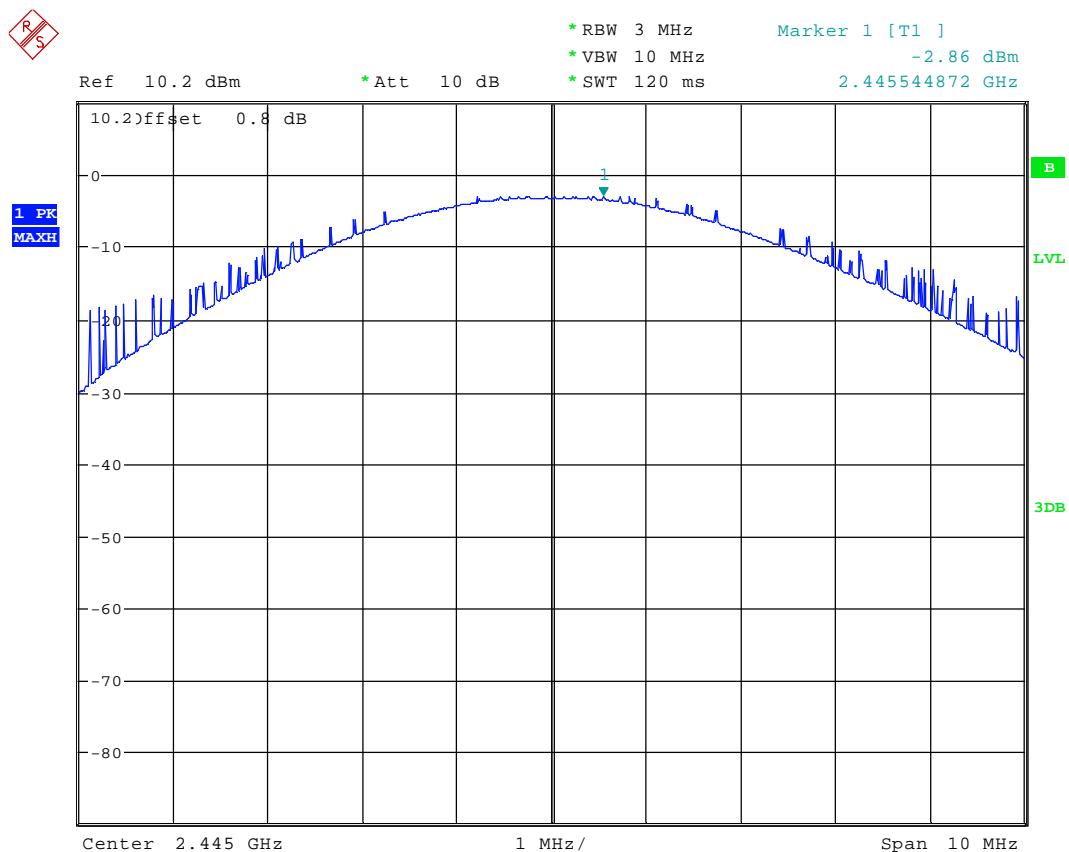
Date: 20.JAN.2011 11:43:36

Conducted carrier power 2.405GHz



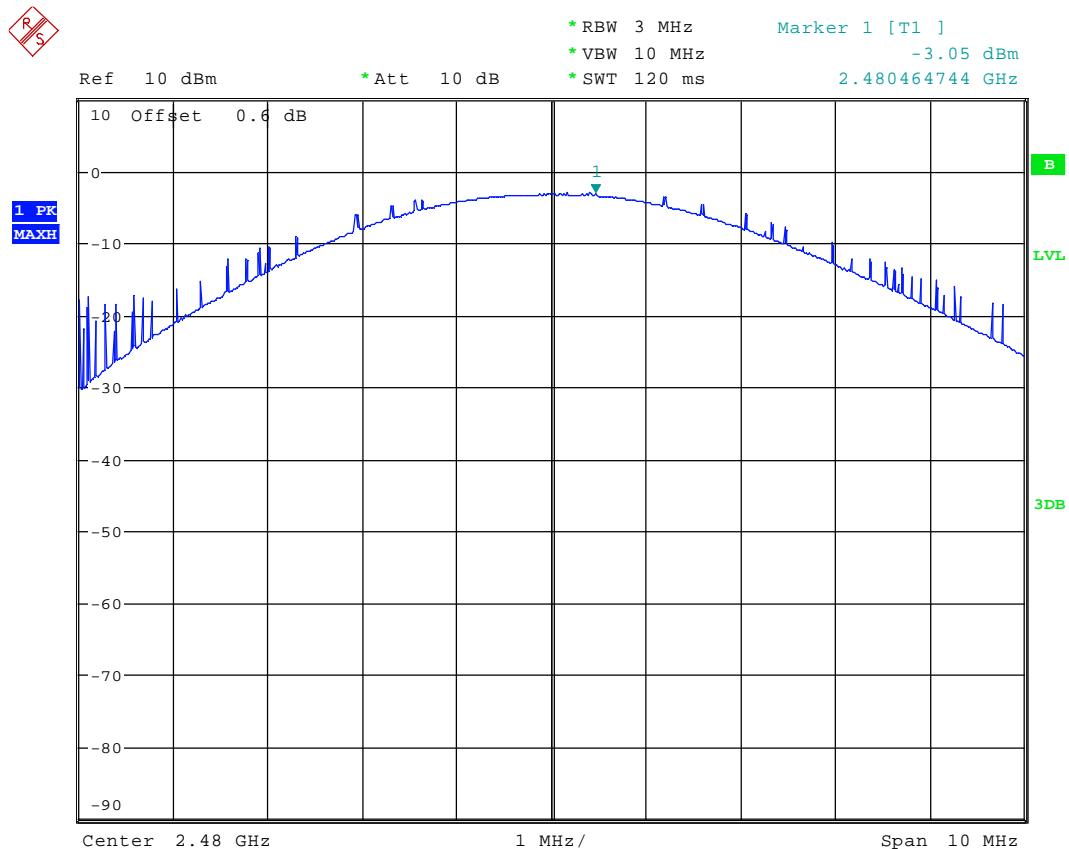
Date: 19.JAN.2011 16:32:31

Conducted carrier power 2.445GHz



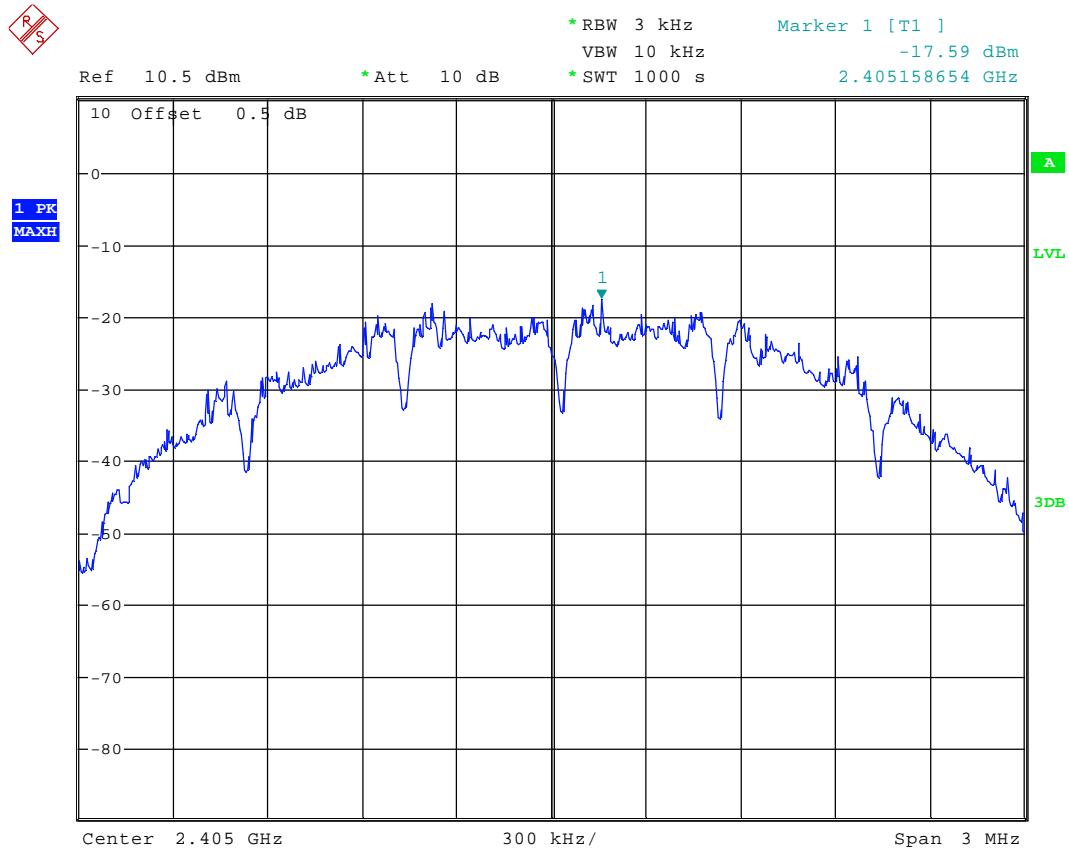
Date: 19.JAN.2011 16:34:16

Conducted carrier power 2.480GHz



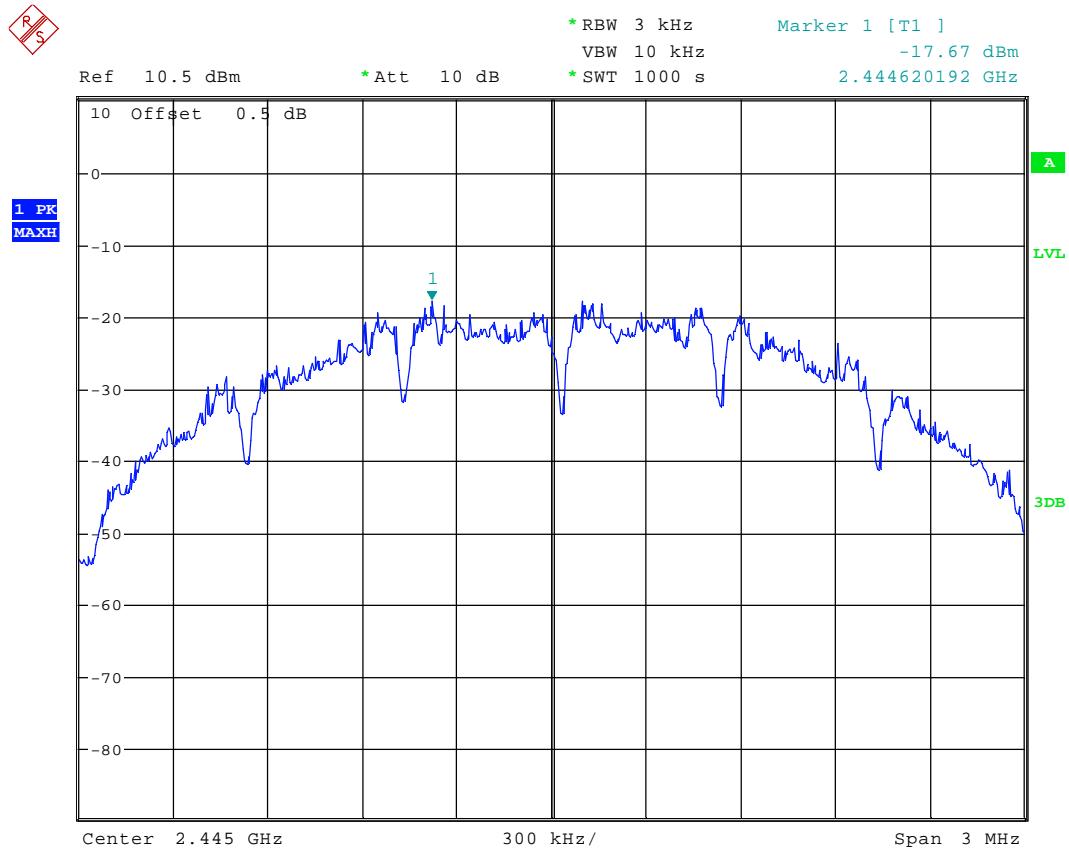
Date: 19.JAN.2011 16:38:38

Conducted power spectral density 2.405GHz



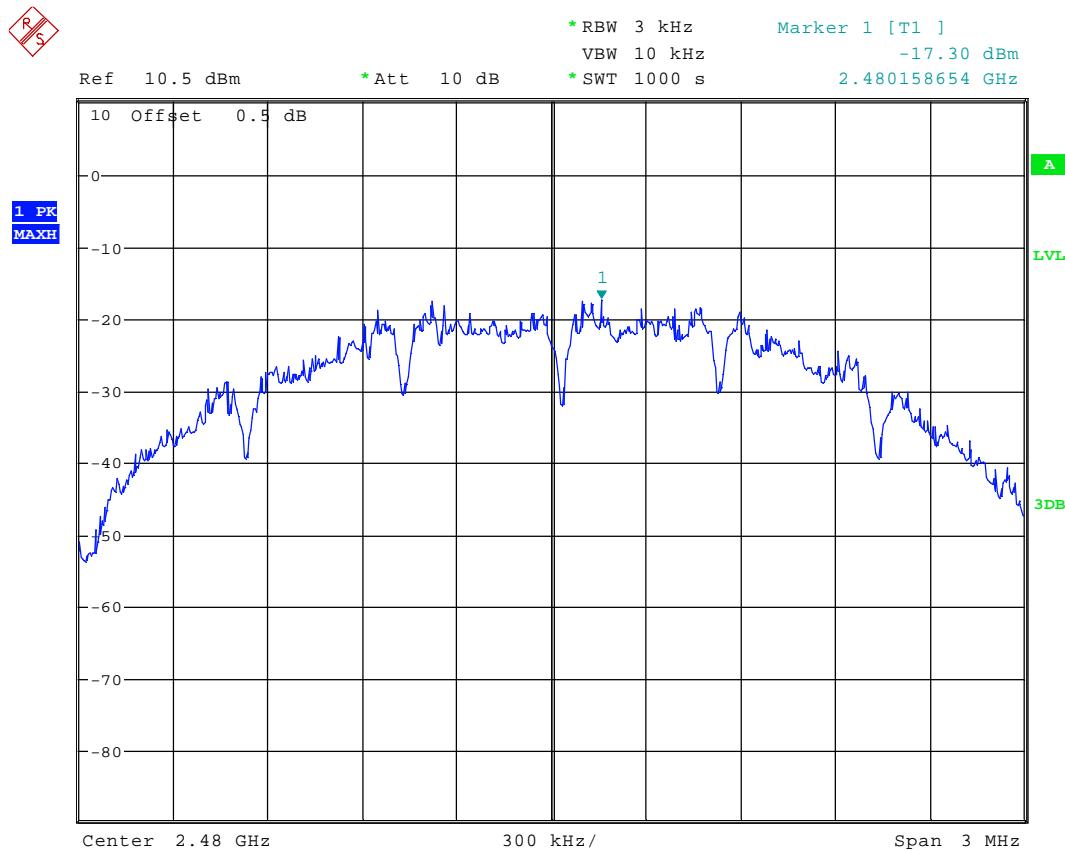
Date: 3.FEB.2011 08:35:01

Conducted power spectral density 2.445GHz



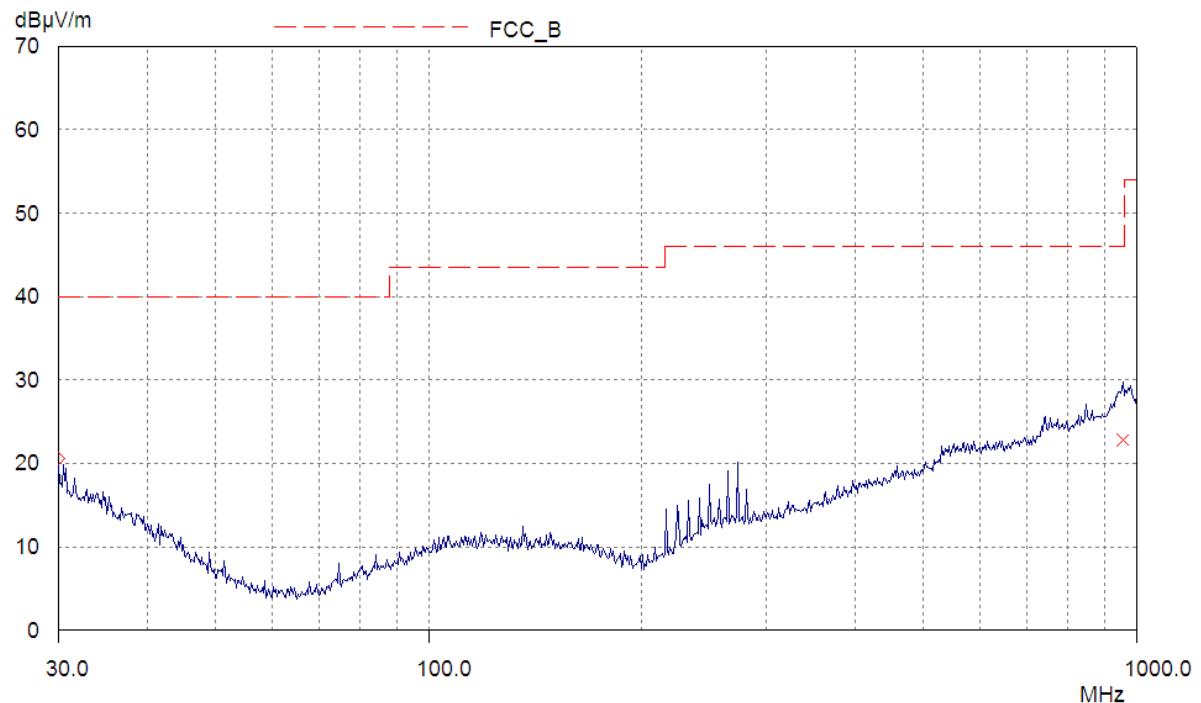
Date: 3.FEB.2011 08:59:48

Conducted power spectral density 2.480GHz

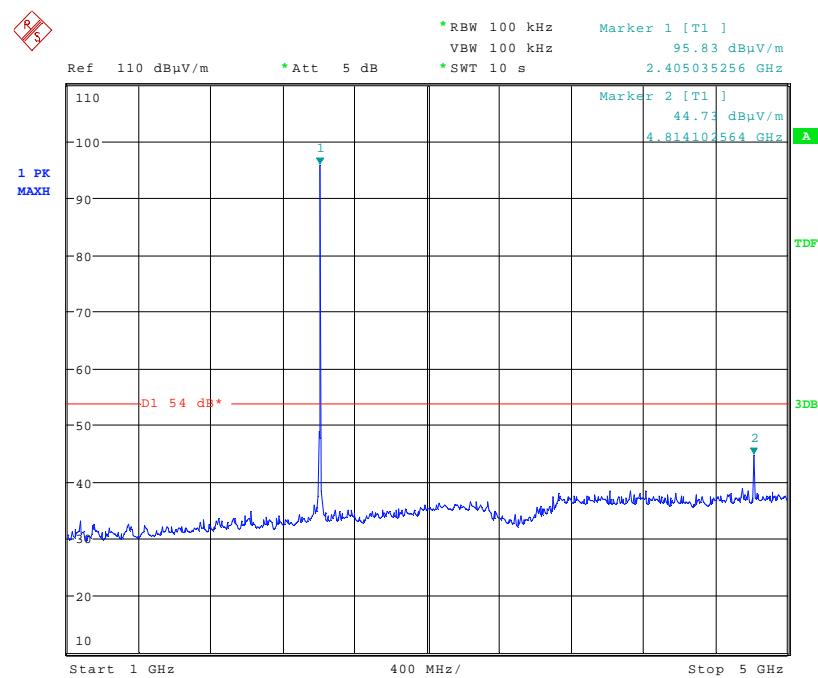


Date: 3.FEB.2011 09:20:00

Radiated Spurious emissions 30MHz to 1GHz – Bottom channel

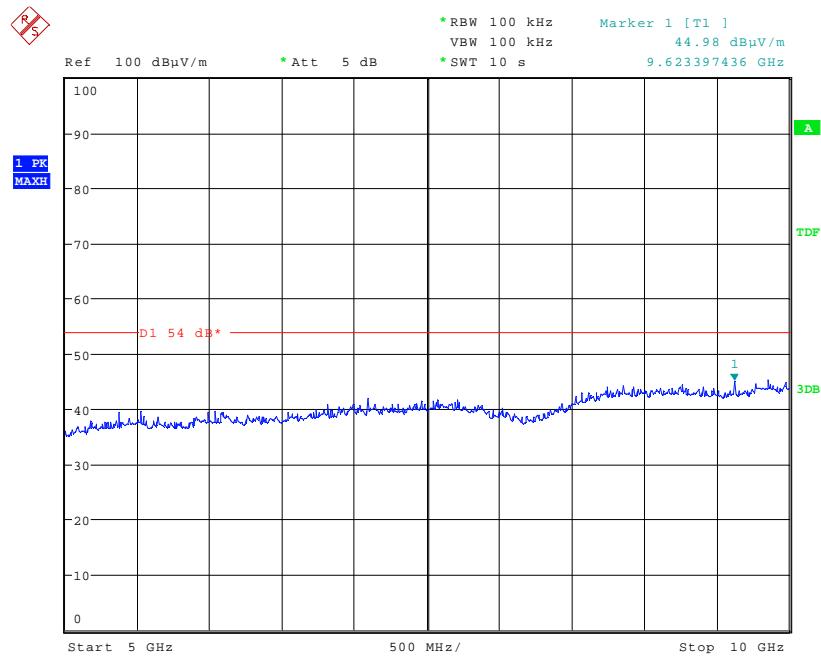


Radiated Spurious emissions 1GHz to 5GHz – Bottom channel



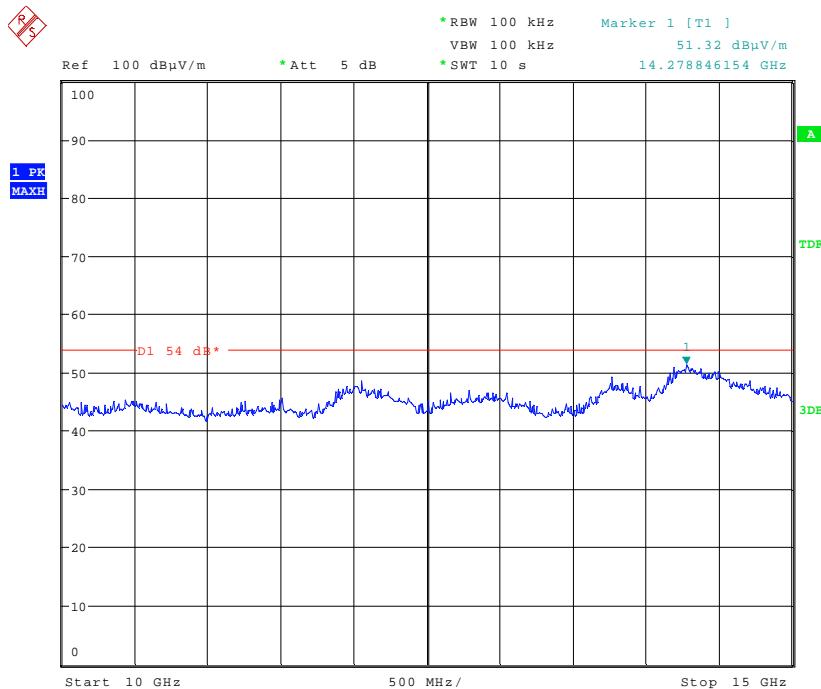
Date: 24.JAN.2011 16:17:16

Radiated Spurious emissions 5GHz to 10GHz – Bottom channel



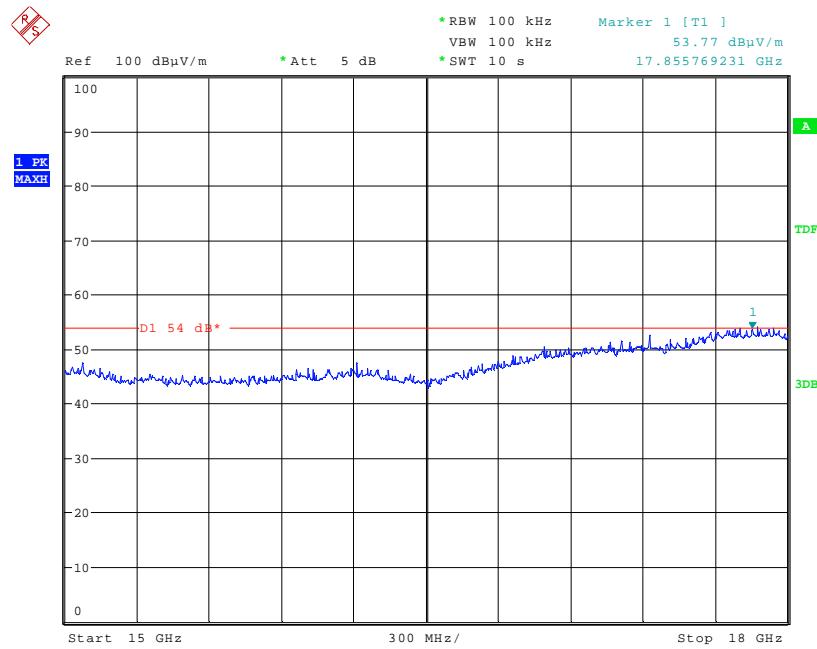
Date: 24.JAN.2011 15:41:17

Radiated Spurious emissions 10GHz to 15GHz – Bottom channel



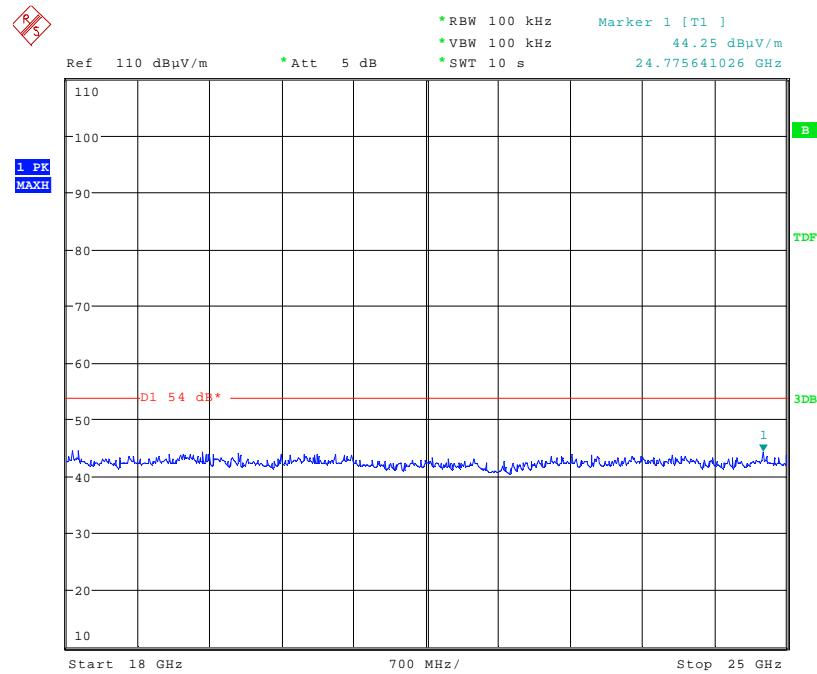
Date: 24.JAN.2011 15:41:55

Radiated Spurious emissions 15GHz to 18GHz – Bottom channel



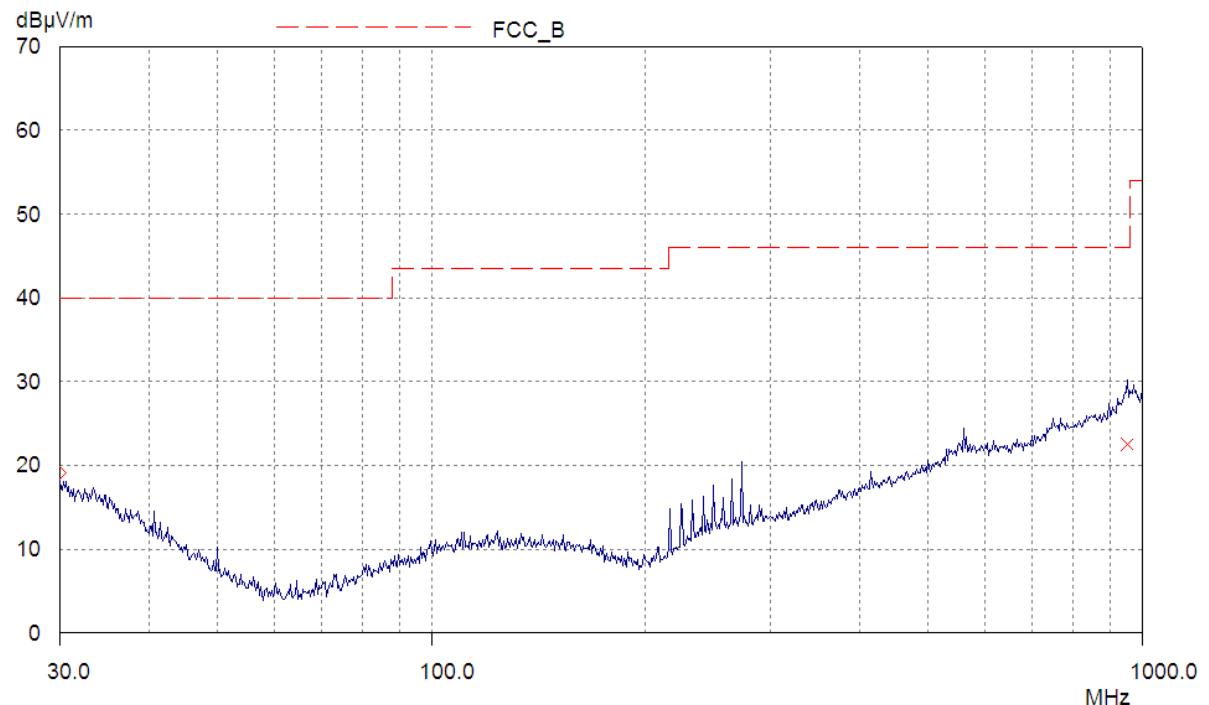
Date: 24.JAN.2011 15:42:51

Radiated Spurious emissions 18GHz to 25GHz – Bottom channel

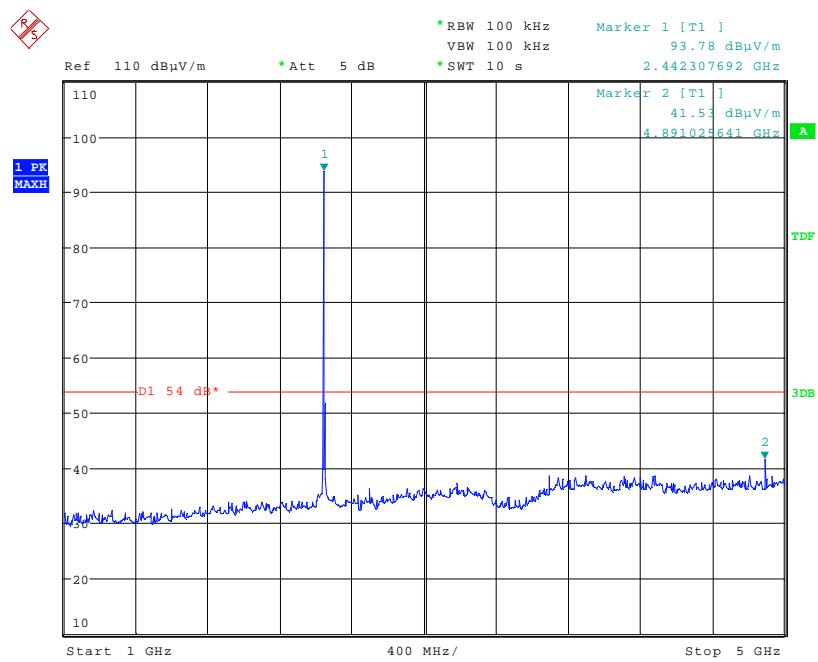


Date: 25.JAN.2011 08:48:30

Radiated Spurious emissions 30MHz to 1GHz – Middle channel

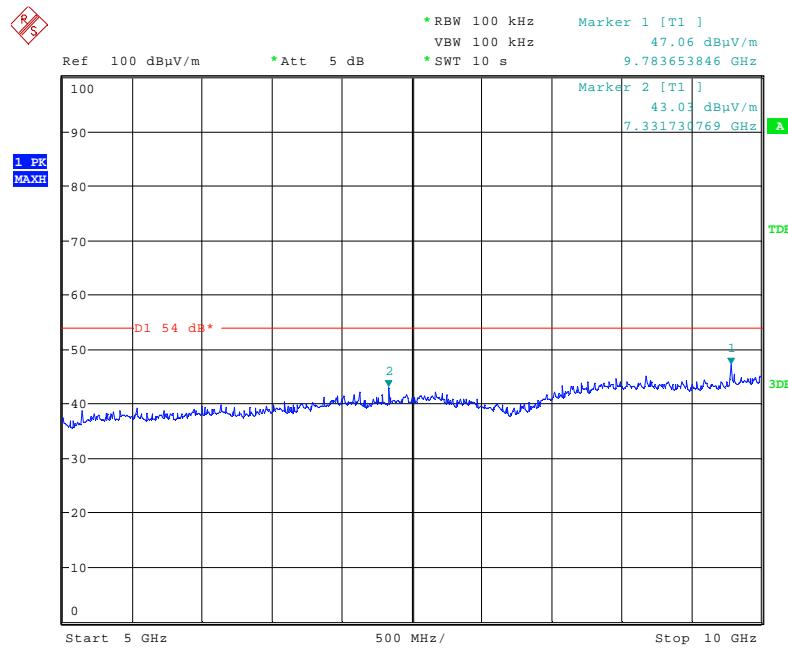


Radiated Spurious emissions 1GHz to 5GHz – Middle channel



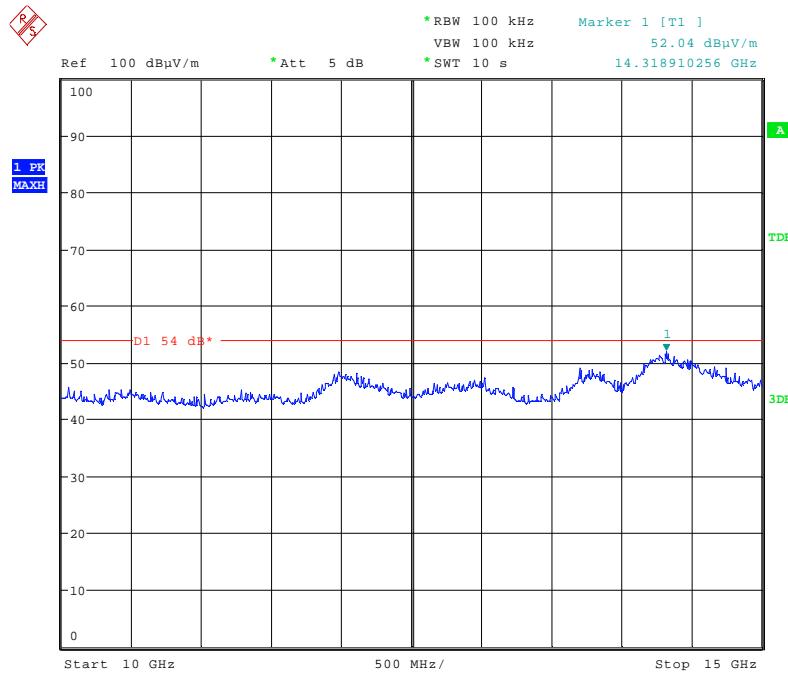
Date: 24.JAN.2011 16:19:12

Radiated Spurious emissions 5GHz to 10GHz – Middle channel



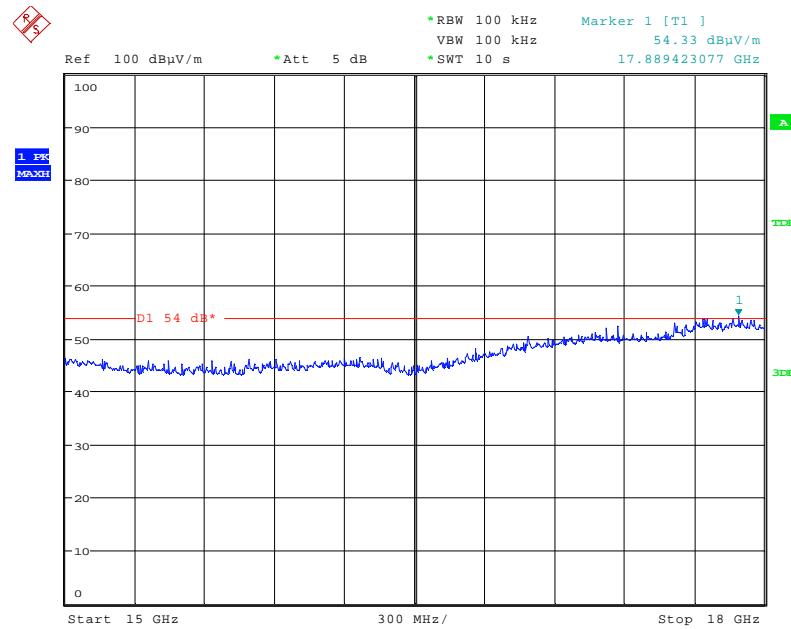
Date: 24.JAN.2011 15:46:34

Radiated Spurious emissions 10GHz to 15GHz – Middle channel



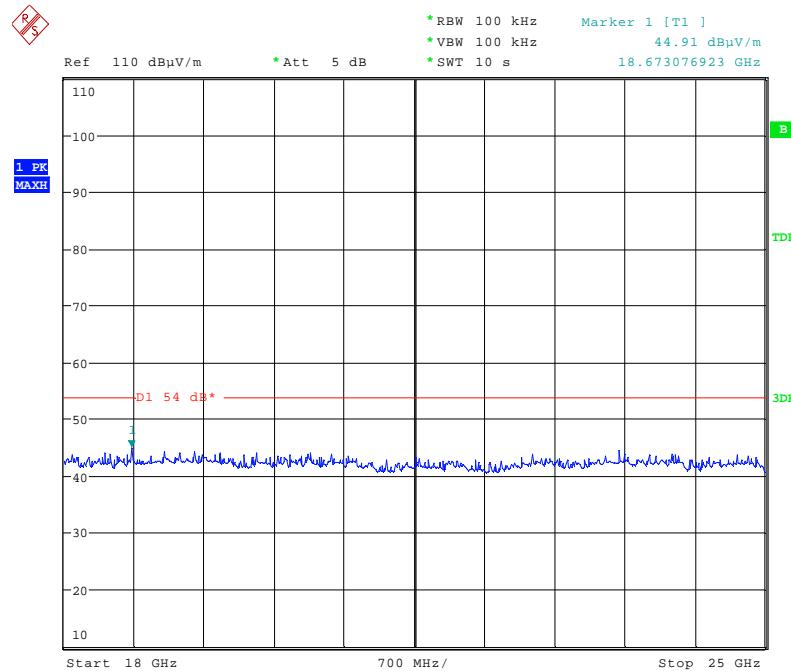
Date: 24.JAN.2011 15:47:24

Radiated Spurious emissions 15GHz to 18GHz – Middle channel



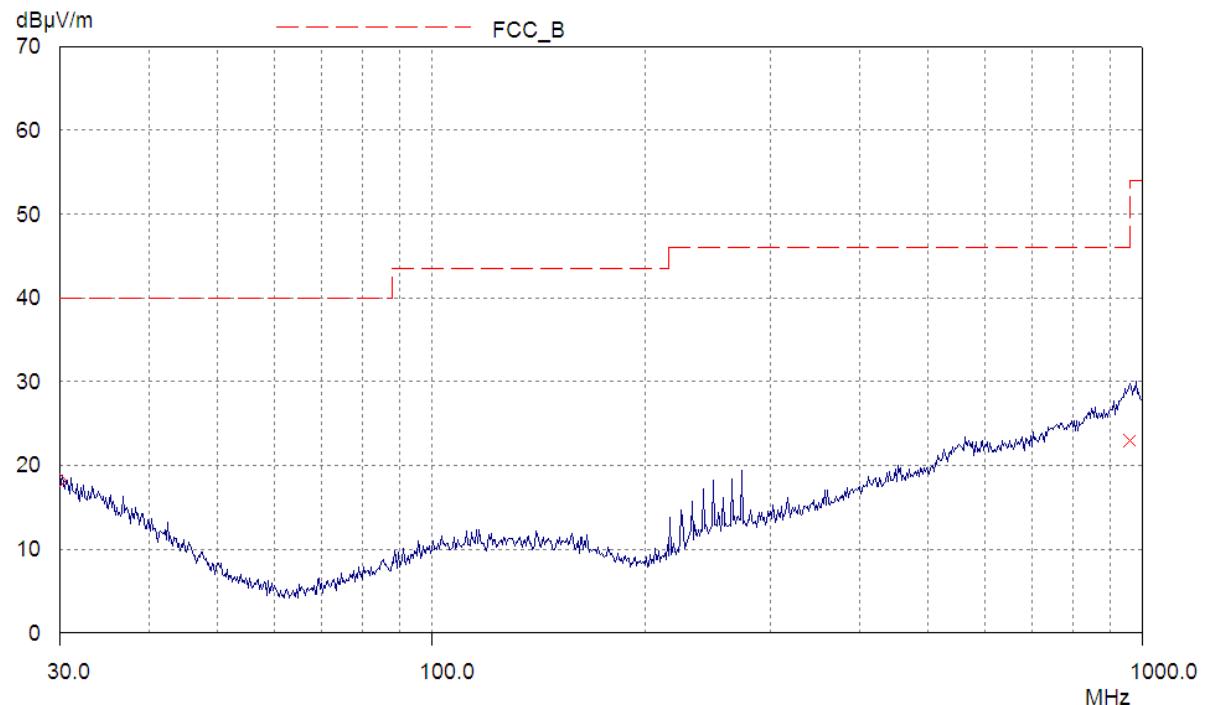
Date: 24.JAN.2011 15:48:02

Radiated Spurious emissions 18GHz to 25GHz – Middle channel

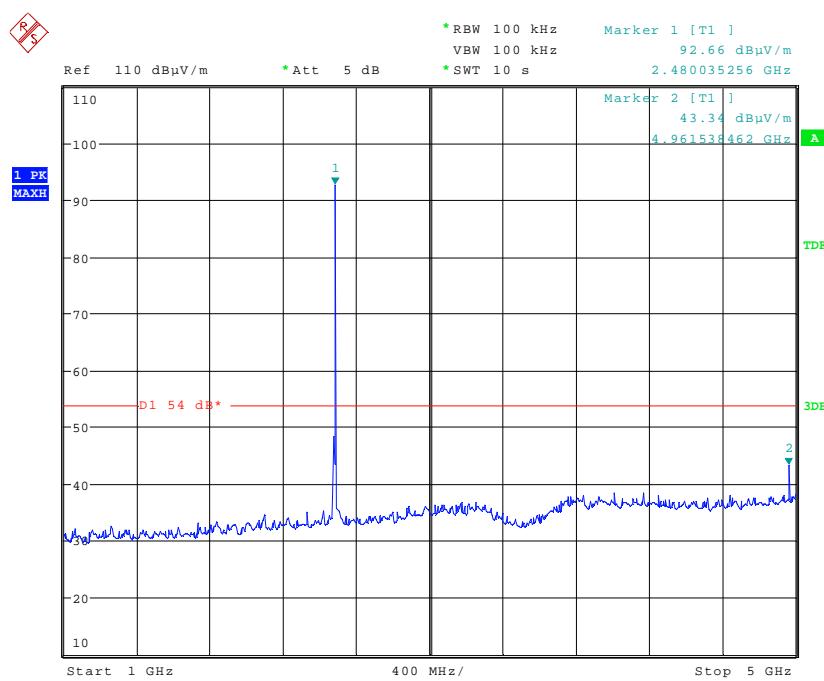


Date: 25.JAN.2011 08:51:41

Radiated Spurious emissions 30MHz to 1GHz – Top channel

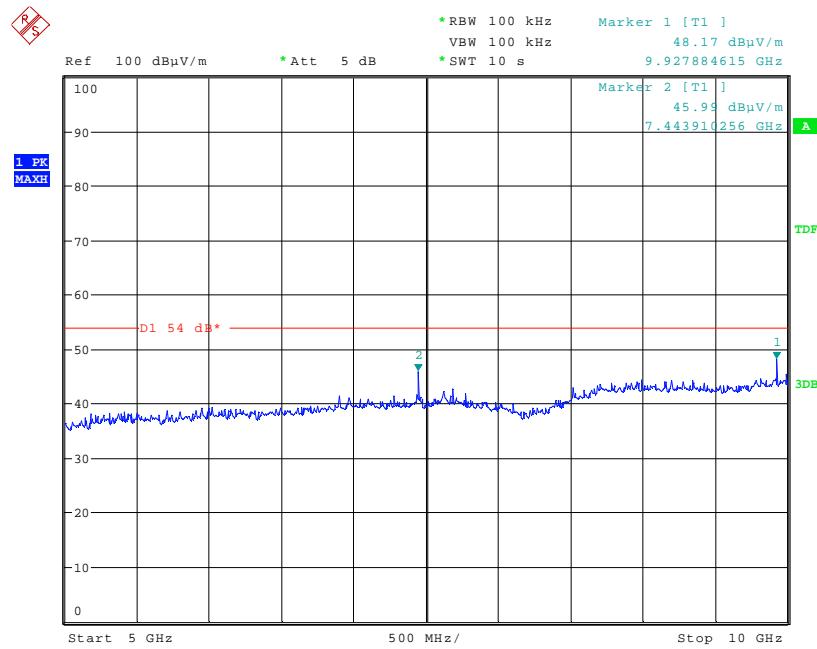


Radiated Spurious emissions 1GHz to 5GHz – Top channel



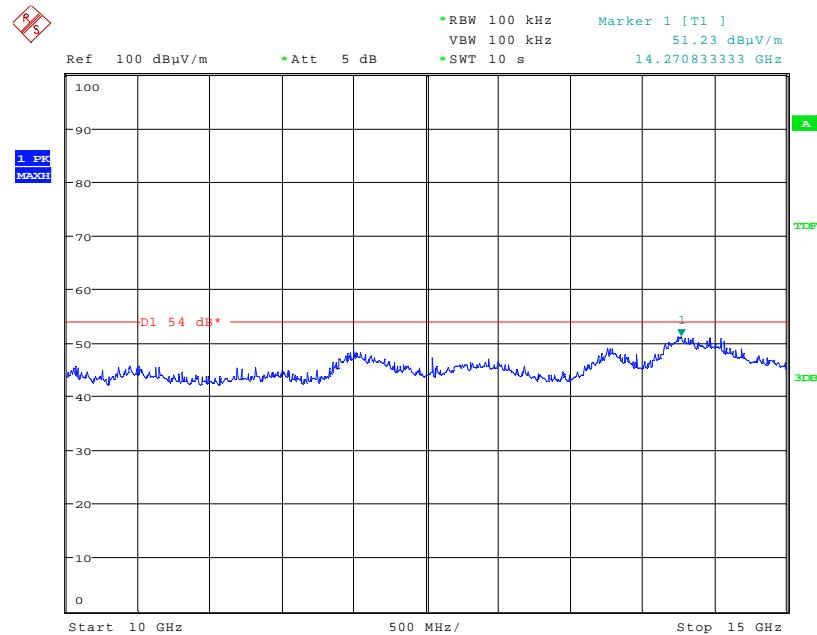
Date: 24.JAN.2011 16:24:47

Radiated Spurious emissions 5GHz to 10GHz – Top channel



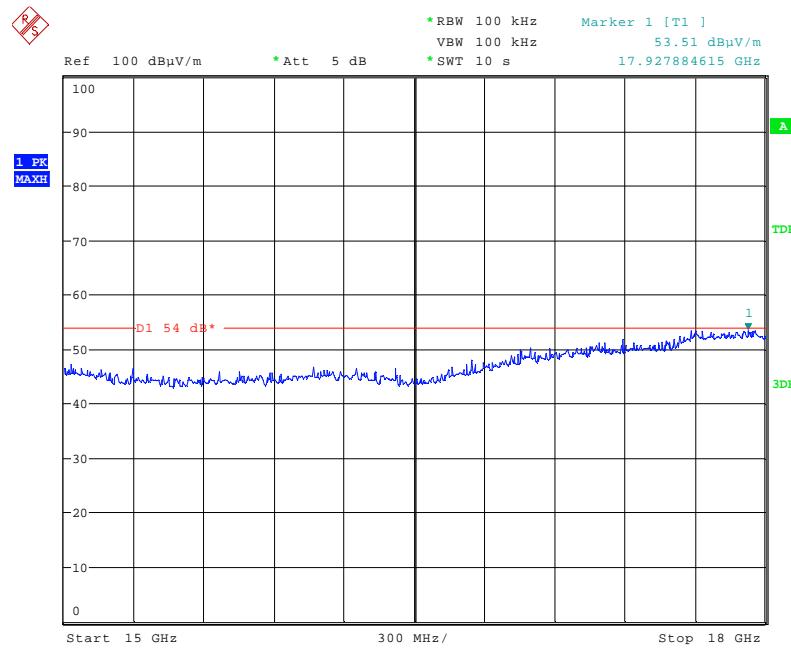
Date: 24.JAN.2011 15:50:03

Radiated Spurious emissions 10GHz to 15GHz – Top channel



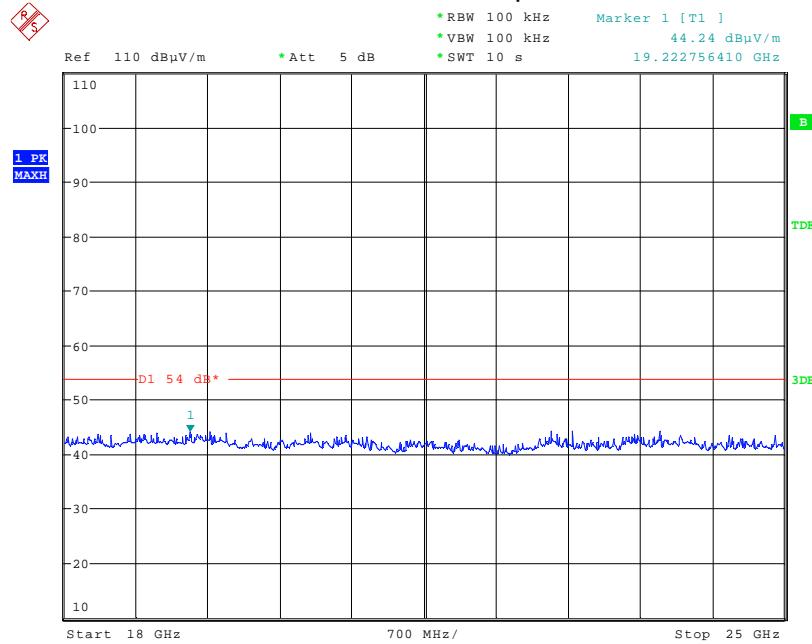
Date: 24.JAN.2011 15:50:43

Radiated Spurious emissions 15GHz to 18GHz – Top channel



Date: 24.JAN.2011 15:51:18

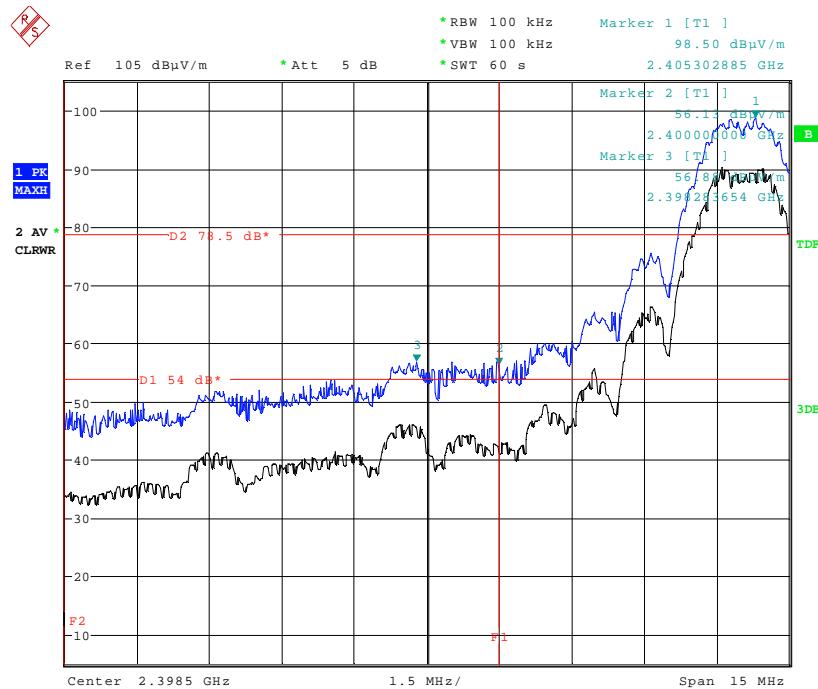
Radiated Spurious emissions 18GHz to 25GHz – Top channel



Date: 25.JAN.2011 09:31:42

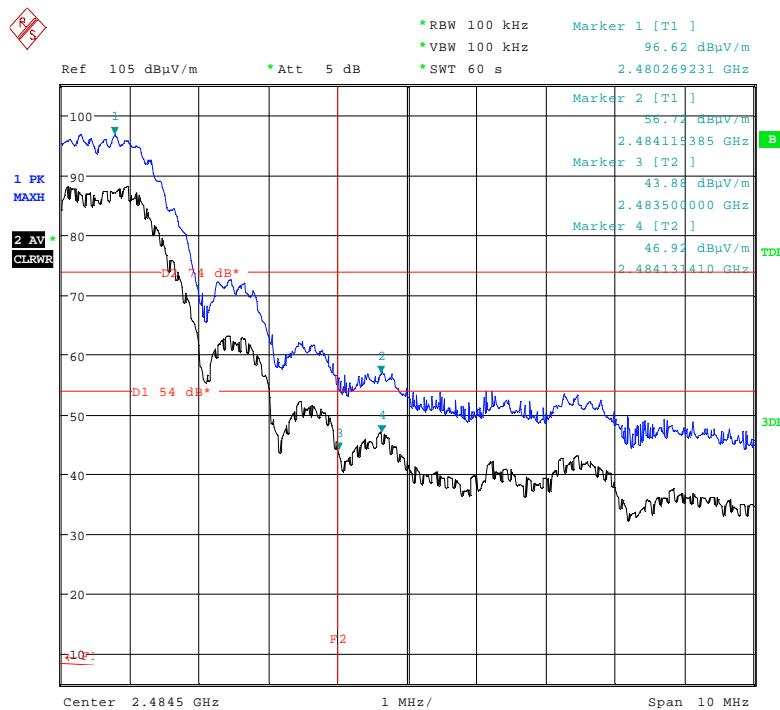
Radiated Bandedge Compliance

Lower Bandedge



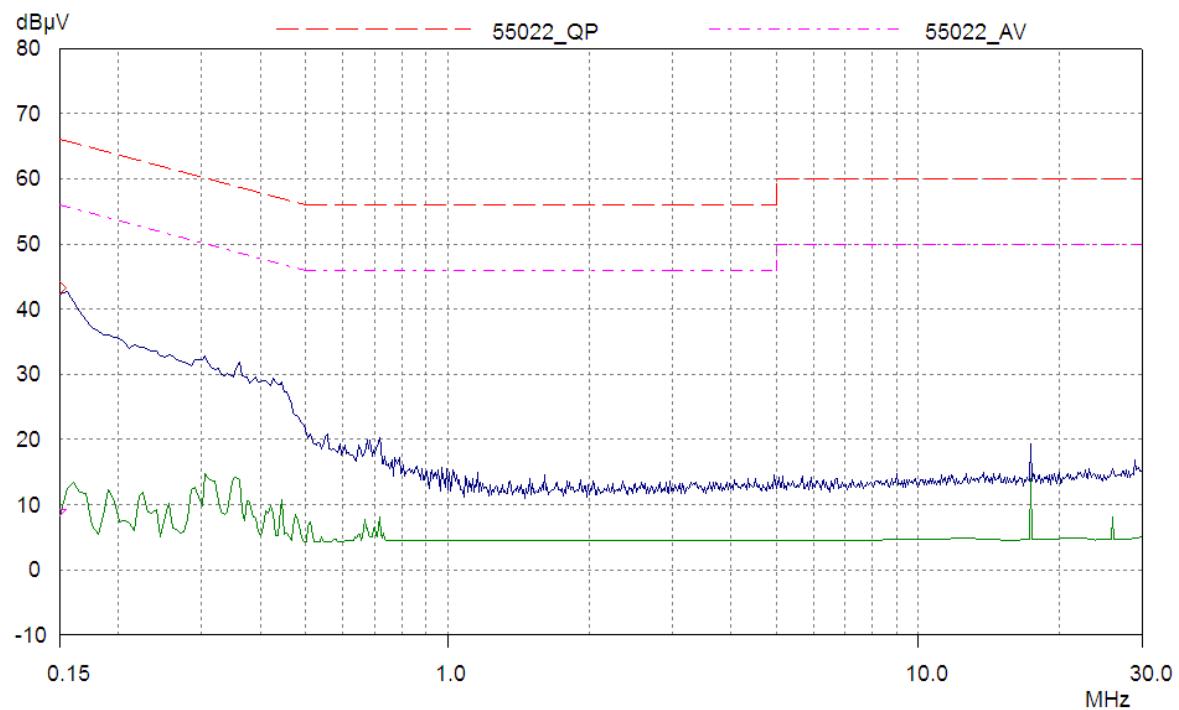
Date: 25.JAN.2011 09:53:12

Upper Bandedge

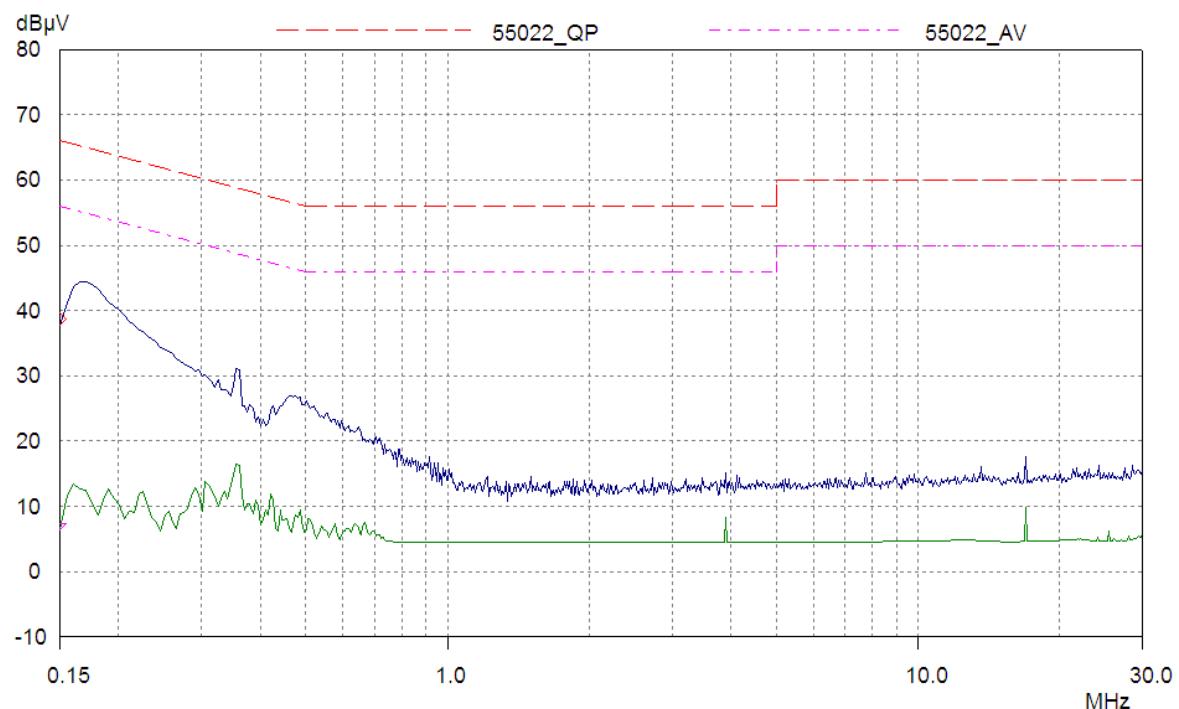


Date: 25.JAN.2011 10:05:33

Ac Powerline Emissions Live Line



Ac Powerline Emissions Neutral Line



Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing.
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below).
4. EUT arrangement (see below).

Throughout testing, the following numbering system is used to identify the sample and its modification state:

Sample No: Sxx Mod w

where:

xx	= sample number	eg. S01
w	= modification number	eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

- Positioning of cards in a chassis.
- Setting of any internal switches.
- Circuit board jumper settings.
- Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as "single possible configuration".

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Telecoms & Radio upon request.

C1) Test samples

The following samples of the apparatus were submitted by the client for testing :

Sample No.	Description	Identification
S02	Main Controller	N/A

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
N/A	Not Applicable. No support equipment required	

The following samples of apparatus were supplied by TRaC Telecoms & Radio as support or drive equipment (auxiliary equipment):

Identification	Description
N/A	Not Applicable. No support equipment required

C2) EUT Operating Mode During Testing.

During testing, the EUT was exercised as described in the following tables :

Test	Description of Operating Mode
All tests detailed in this report	Transmit and receive test channels are selected via Dip switches On the EUT. CW and modulation selected via Dip switches On the EUT. Transmit and receive channels tested on bottom, Middle, and Top channels.

C3) EUT Configuration Information.

The EUT was submitted for testing in one single possible configuration.

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S02
 Tests : Conducted

Port	Description of Cable Attached	Cable length	Equipment Connected
Test input 1	1 mtr un terminated	1m	None
Test input 2	1 mtr un terminated	1m	None
12-24Vdc/Ac	1 mtr Supply Lead	1m	24Vdc battery
12-24Vdc/Ac	1 mtr Supply Lead	1m	24Vdc battery
Low Battery NC	1 mtr un terminated	1m	None
Low Battery COM	1 mtr un terminated	1m	None
8k2	1 mtr un terminated	1m	None
8k2COM	1 mtr un terminated	1m	None
NC	1 mtr un terminated	1m	None
NC COM	1 mtr un terminated	1m	None

Sample : S02
 Tests : Radiated Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Test input 1	1 mtr un terminated	1m	None
Test input 2	1 mtr un terminated	1m	None
12-24Vdc/Ac	1 mtr Supply Lead	1m	24Vdc battery
12-24Vdc/Ac	1 mtr Supply Lead	1m	24Vdc battery
Low Battery NC	1 mtr un terminated	1m	None
Low Battery COM	1 mtr un terminated	1m	None
8k2	1 mtr un terminated	1m	None
8k2COM	1 mtr un terminated	1m	None
NC	1 mtr un terminated	1m	None
NC COM	1 mtr un terminated	1m	None

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010
TRL138	3115	1-18GHz Horn Antenna	EMCO	10/09/2009
TRL139	3115	1-18GHz Horn Antenna	EMCO	17/08/2009
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	24/11/2010
TRLUH04	ESHS10	Receiver	Rhode & Schwarz	14/12/2010
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	08/11/2010
TRLUH372	6201-69	30MHz – 1 GHz Pre Amplifier	Watkins Johnson	14/04/2010

For Conducted Measurements

TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	29/01/2010

Appendix D:

Additional Information

No additional information is included within this test report.

Appendix E:**Calculation of the duty cycle correction factor**

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB = $20 \times (\log_{10} \text{Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

Duty cycle = the sum of the highest average value pulsewidths over 100ms
100ms

e.g

$$= \frac{7.459 \text{ms}}{100 \text{ms}} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) = $20 \times (\log_{10} 0.07459) = -22.54 \text{dB}$

Appendix F:

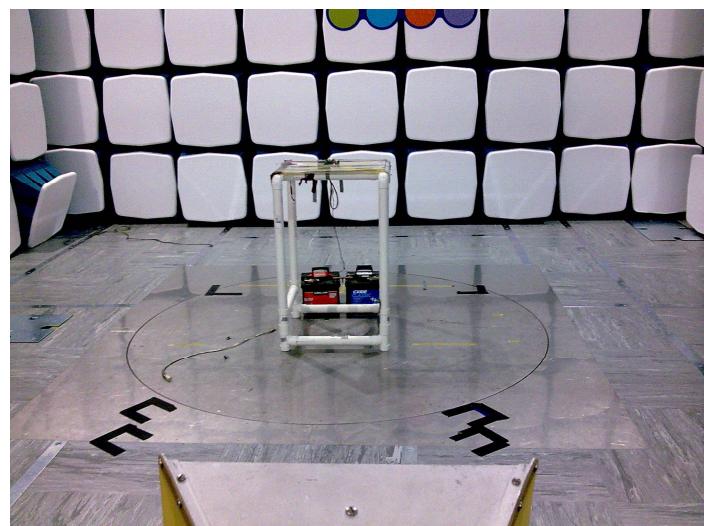
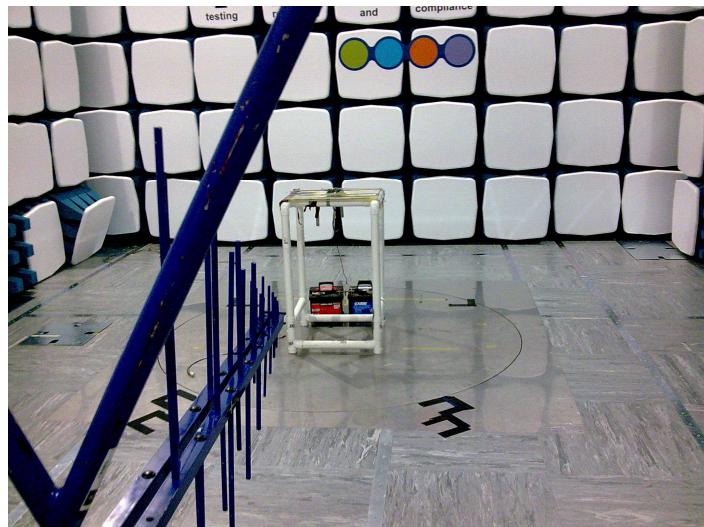
Photographs and Figures

The following photographs were taken of the test samples:

1. Test setups.
2. Top and Underside view PCB

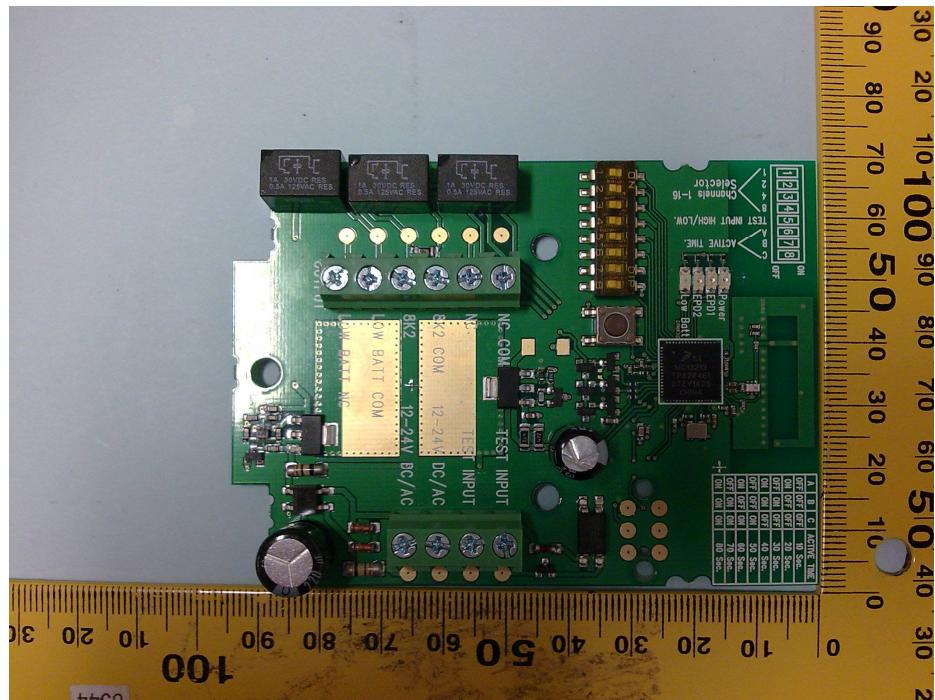
Photograph 1

Setup Photographs

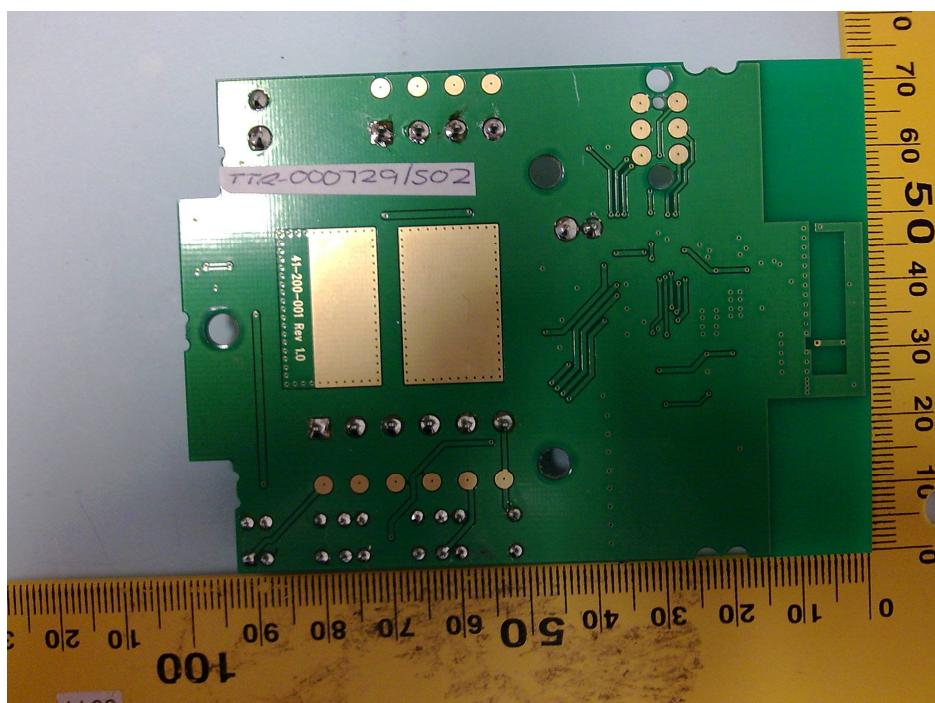


Photograph 2

Top View PCB



Underside View PCB



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